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# THE ANATOMY OF THE *Human Bones and Nerves*:

WITH

An Account of the reciprocal Motions of the HEART,

AND

A Deſcription of the HUMAN LACTEAL SAC and DUCT.

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By ALEXANDER MONRO, *Profeſſor of Anatomy in the Univerſity of* Edinburgh, *and* F. R. S.

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The FOURTH EDITION Corrected and Enlarged.

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BRITISH MUSEUM
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# TO THE
# Students of Anatomy
# IN THE
# *Univerſity of* EDINBURGH;

GENTLEMEN,

*W*HEN *I firſt engaged to publiſh an* Oſteology, *I had no near View of your being favoured with Treatiſes on the ſame Subject by ſo many great Maſters in Anatomy as have wrote ſince that Time. Had I known that* Albinus, Winſlow *and* Palfyn *were to have publiſhed Deſcriptions of the human Bones, my Papers probably would have remained yet undelivered to the Printers: I however flatter myſelf, that this* Eſſay *has* *been of Uſe to the Gentlemen who did me the Honour to attend my Colleges, by aſſiſting them to underſtand my Senſe and Repreſentation of Things in this fundamental Part of Anatomy; and that it has poſſibly been of more Advantage to them than a more complete Work from an abler Hand, unleſs my Demonſtrations had been in the Order and Method of ſuch an Author.*

*This View of your Improvement, Gentlemen, is a prevailing Argument with me, to cauſe this Eſſay to be reprinted, and you cannot reaſonably blame me, if I likewiſe acknowledge another Motive for it, which more particularly relates to myſelf. In a new Edition an Author has an Opportunity of making his Works more correct, complete, and conſequently acceptable to the Publick, who may perhaps be indulgent enough to think this little Treatiſe not altogether uſeleſs, ſince more Reaſoning on the Structure and morbid Phænomena of Bones is to be found in it, than in the other Writers, who have confined themſelves almoſt entirely to the deſcriptive or proper anatomical Part of the* Oſteology.

*I have here kept to the Plan of the former Editions, by firſt conſidering, in the Order that ſeemed to me moſt natural and methodical, every thing which I thought neceſſary*

*ſary to be known concerning Bones in general; and in the ſecond Part, I have deſcribed the ſeveral Bones compoſing the Skeleton.*

*The Bones of Adults are what I principally endeavour to deſcribe, but I have added as much of the* Oſteogenea, *as I think ſerviceable in the Practice of Phyſick and Surgery.*

*That little might be omitted of what was formerly done on this Subject, I have taken all the Aſſiſtance I could from Books, but have never aſſerted any anatomical Fact on their Authority without conſulting the Life, from which all the Deſcriptions are made; and therefore the Quotations from ſuch Books, ſerve only to do Juſtice to the Authors, who have remarked any Thing in the Structure of the Parts that was commonly omitted, and to initiate you in the Hiſtory of Anatomy, which I once propoſed to make complete, ſo far as related to this Subject; but not being able to procure ſeveral Books, and being ſenſible how many more may have never come to my Knowledge, I laid aſide this Deſign, of Purpoſe omitted many I could have inſerted, and in ſome Places changed an older Author for a later one, who has more fully or clearly deſcribed what I treated of. Beſide Anatomiſts, I have alſo* *ſo named ſeveral other Authors to confirm my Reaſoning by practical Caſes, of which it is not to be ſuppoſed my Experience could furniſh a ſufficient Variety.*

*You'll readily obſerve, that I quote no Paſſages with a View to criticiſe or condemn them. This Precaution of giving no Offence, is very neceſſary in thoſe who are ſufficiently conſcious of their being liable to lay themſelves open to juſt Cenſure; and it prevents Occaſions of uſeleſs Wrangling, in which generally both Parties are Loſers, and the Publick has little Advantage.*

*In this Treatiſe I always make uſe of the moſt common Name of each Part, and have put the ſynonymous Names to be met with in Books at the Foot of the Page, that the Reading might be ſmoother, and you might conſult them at your Leiſure, to aſſiſt you in underſtanding different Authors.*

*The Deſcriptions and Reaſoning are here blended, without which I always find younger Anatomiſts ſoon are diſguſted with Authors; their Imaginations cannot follow a long Chain of Deſcriptions, eſpecially when they are not taught at the ſame Time the Uſes which the deſcribed Parts ſerve: Their Minds muſt have ſome Relaxation by a Mixture of Reaſoning, which never miſſes to ſtrike the Fancy agreeably, and raiſes a ſtrong Deſire* *to underſtand the Principles on which it depends.*

*The* Phænomena *of Diſeaſes are all deduced in this Eſſay from the Structure of the Parts, by Way of Corollaries and Queſtions, which ſuch an anatomical Work confined me to; and this Method has otherwiſe a good Effect: For when one meets with an uſeful Propoſition, and is obliged to employ a little Thought to find out its Solution, the Impreſſion it makes is deeper, and he acquires a Fondneſs of it, as being in Part his own Diſcovery. My Pupils have frequently aſſured me, that they could, with very ſmall Reflexion, trace out the whole Reaſoning from which my Concluſions were drawn; I hope their Succeſſors will alſo think this an agreeable Manner of being inſtructed.*

*Thoſe Gentlemen who deſired I would add the Lectures I pronounce in my Colleges as a Commentary upon the Text, where the Diſeaſes are mentioned, will, I perſwade myſelf, excuſe me for not complying with their Deſire, when they conſider the Deſign of this is to be a School-Book, and how great the Difference is between inſtructing Youth in private, and pretending to inform the Publick;* Art. xxiv. Vol. v. *of Medical Eſſays and Obſervations publiſhed in this Place*

*Place is one of theſe Lectures which I gave as a Commentary on the Paragraph (p. 13.) concerning the different kinds of* Caries.

*In this Edition, I have corrected the Miſtakes and obſcure Paſſages which I diſcovered in the former, and in ſome Places I have made the Deſcriptions more full and exact, aiming all I could to ſhun unneceſſary Minuteneſs on the one Hand, and a blameable Inaccuracy on the other: Whether I have hit that juſt Medium, is what you and the Publick muſt now judge.*

*I am ſtill of Opinion that Figures of the Bones, would at any Rate have been unneceſſary in a Book that is intended to be illuſtrated and explained by the Originals themſelves, but would be much more ſo now, when my ingenious Friend Mr.* Cheſelden, *and Dr.* Albinus *have publiſhed ſuch elegant Ones; and the Pictures in the* Oſteography *publiſhed here, are diſpoſed in the Order which I follow.*

*You have advantageous Opportunities in this Place of ſtudying all the Parts of Medicine under the Profeſſors of its different Branches in the Univerſity, and of ſeeing the Practice of Pharmacy, Surgery and Phyſick, with our Surgeon-Apothecaries and in the Infirmary, where the diſeaſed Poor are carefully treated. Theſe your Intereſt, and, I hope,*

*hope, your Inclinations will lead you, Gentlemen, ſo to improve, as they may prove the happy Means of your making a conſiderable Figure in your ſeveral Stations. Whatever Aſſiſtance is in my Power towards ſuch a deſireable Event, ſhall be given with the greateſt Pleaſure by,*

*Your humble Servant,*

ALEXr. MONRO.

THE

# THE ANATOMY OF THE Human Bones.

## PART I.

### Of the Bones in general.

BONES are covered externally by a Membrane named on that Account PERIOSTEUM †, which is ſo neceſſary to the Bones, that we muſt examine its Texture and Uſes, before we can underſtand their Structure.

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† *Membrana circumoſſalis, omentum oſſibus impoſitum.*

The *Perioſteum* as well as moſt other Membranes can be divided into *Layers* of Fibres. The *exterior* ones being compoſed of the Fibres of the Muſcles connected to the Bones, vary in their Number, Size and Direction, and conſequently occaſion a very great Difference in the Thickneſs and Strength of the *Perioſteum* of different Bones, and even of the different Parts of the ſame Bone.—— The *internal* Layer is every where nearly of a ſimilar Structure, and has its Fibres in the ſame Direction with thoſe of the Bone to which they are contiguous. Ought not then the Name *Perioſteum* to be applied, ſtrictly ſpeaking, only to this internal Layer, to which the exterior ones are joined in an uncertain Manner and Number?

Some Authors endeavour to prove the internal Layer of Fibres of the *Perioſteum* to be derived from the *dura Mater*: For, ſay they, ſince the Membrane covering the Scull is plainly a Production or Continuation of the *dura Mater*, which paſſes out between the Sutures; and ſince there are Muſcles on the Head, as well as in other Parts, which might furniſh a *Perioſteum*, 'tis needleſs to aſſign different Origins to Membranes which have the ſame Texture and Uſes. Nay *Havers* (*a*) adds further, in proof of this Doctrine, (and his Obſervation in general is true,) that he can demonſtrate the *Perioſteum* to be continued from one Bone to another, by proſecuting and raiſing it from the Ligaments which cover the Articulations. The great Deſign of this Arguing is, to ſupport an Hypotheſis which prevailed a conſiderable Time, of all Mem-

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(*a*) Oſteolog. nov. Diſc. 1.

Membranes being derived from one or other of the two that cover the Brain; otherwiſe it is to no Purpoſe to diſpute whether the *Perioſteum* is a Production or Continuation of the *dura Mater*, or if it ought to be eſteemed a diſtinct Membrane, ſo long as we rightly underſtand its Structure and Uſes.

Except where Muſcles are inſerted into the *Perioſteum*, it is connected to the ſurrounding Parts by thin cellular Membranes, which collapſe into ſuch a ſmall Space, when they are cut or broken in taking out a Bone, that the external Surface of the *Perioſteum* ſeems very ſmooth and equal.

When we attempt to tear off the *Perioſteum* from the Bone, we ſee a great Number of white Threads produced from the Membrane into the Bone. After a ſucceſsful Injection of the Arteries with a red Liquor, numerous Veſſels are not only ſeen on the *Perioſteum* (*a*), but moſt of the Fibres going from the Membrane to the Bone, ſhew themſelves to be Veſſels entring the Bone, with the injected Liquor in them; and, when they are broken, by tearing off the *Perioſteum*, the Surface of the Bone is almoſt covered with red Points.

The Veins correſponding to theſe Arteries are ſometimes to be ſeen in Subjects that die with their Veſſels full of Blood, tho' ſuch numerous Ramifications of them cannot be demonſtrated as of the Arteries, the Veins being incapable of allowing an injected Liquor to paſs from their Trunks into their minute Branches.

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(*a*) *Ruyſch* Epiſt. 5. Tab. 5. fig. 1, 2. Epiſt. 8. Tab. 9. Fig. 1, 2.

The great Senſibility of the *Perioſteum* in the deep-ſeated Species of *Paronychia*, in *Exoſtoſes*, *Nodi*, *Tophi* and *Gummata* from a *Lues venerea*, is a ſufficient Proof that it is well provided with Nerves, though they are too ſmall to be traced upon it; and therefore one cannot well determine, whether they are ſent along with the Arteries in the common Way, or are derived from the tendinous Fibres of the Muſcles expanded on the *Perioſteum*.

Veſſels alſo paſs through the *Perioſteum* to the Marrow; of which more hereafter. And frequently the Muſcles pierce through the *Perioſteum* to be inſerted into the Bones.

The chief Uſes of the *Perioſtium* are: 1. To allow the Muſcles, when they contract or are ſtretched, to move and ſlide eaſily upon the Bones, the ſmooth Surface of this Membrane preventing any ill Effects of their Friction upon each other. 2. To keep in due Order, and to ſupport the Veſſels in their Paſſage to the Bones. 3. By being firmly braced on the Bones, to aſſiſt in ſetting Limits to their Increaſe, and to check their Overgrowth. 4. To ſtrengthen the Conjunction of the Bones with their *Epiphyſes*, Ligaments and Cartilages, which are eaſily ſeparated in young Creatures, when this Membrane is taken away. 5. To afford a convenient Origin and Inſertion to ſeveral Muſcles which are fixed to this Membrane. And *laſtly*, to warn us when any Injury is offered to the Parts it covers, which, being inſenſible, might otherwiſe be deſtroyed without our Knowledge, or endeavouring to procure a Remedy.

When the cellular Subſtance connecting the *Perioſteum* to the ſurrounding Parts is deſtroyed, theſe Parts are fixed to that Membrane, and loſe the ſliding Motion they had upon it; as we ſee daily in Iſſues, or any other tedious Suppurations near a Bone. When the Veſſels which go from the *Perioſteum* to the Bones, are broken or eroded, a Collection of their Liquids is made between the Membrane and Bone, which produces a ſordid Ulcer or rotten Bone. This often is the Caſe after Fractures of the Bones, and Inflammations of the *Perioſteum*, or after *Small-pox*, *Meazles*, *Spotted Fevers*, and *Eryſipelas*. Do not the Diſorders of the *Perioſteum* coming along with or ſoon after the cutaneous Diſeaſes indicate a Similarity of Structure in the *Perioſteum* and Skin?

The Bones are the hardeſt moſt ſolid Parts of the Body, and they are generally of a white Colour, (as all other Parts are, where large Veſſels do not enter;) only in a living Creature the Bones appear bluiſh, which is owing to the Blood in the ſmall Veſſels under their Surface. The leſs therefore and fewer the Veſſels are, and the thicker and firmer the bony Surface covering the Veſſels is, the Bones will appear whiter. Hence the Bones of Adults are whiter than thoſe of Children; and in both Young and Old, the white Colour of different Bones, or of the ſeveral Parts of the ſame Bone, will always be in Proportion to their Veſſels and Solidities; which Circumſtances ought to be regarded by Surgeons, when they are to judge of the Condition of Bones laid bare.

The Bones are compoſed of a great many *Laminæ* or *Plates* †, which are made up of Fibres

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† Squamæ, Bracteæ.

Fibres or Strings laid in a convenient Order and Number, and united by ſmaller Fibrils (*a*); which being irregularly diſpoſed, and interwoven with the other larger Fibres, make a reticular Work.

That the *Plates* of the Bones are compoſed of ſuch Fibres, ſeems probable from the Analogy of the Subſtances that reſemble Bones moſt; ſuch as, Whalebone, or Horns, in which this fibrous Texture is evident.—— A ſtrong Preſumption of ſuch a Texture may likewiſe be had from obſerving that Chinks made in Bones long expoſed to the Weather, or calcined in the Fire, are generally diſpoſed in the Direction which the longitudinal Fibres are found to have. Perhaps nice accurate Obſervations of the different Times that a Bone laid bare, and the Extremity of an amputated Bone, would take to exfoliate, might bid fair to determine the proportional Force of Coheſion which the Particles of the longitudinal Fibres have one to another, in reſpect of that Power by which the Fibres are connected to each other; or, in other Words, the Strength of the longitudinal Fibres compared to the tranſverſe.

The evident Proof of the fibrous and lamellated Structure of Bones is the Examination of the Bones of Fœtuſes, which are not ſo compact and firm as in Adults; for then we ſee the Fibres, and can ſeparate the Plates, and the ſame Structure is to be ſeen in the Bones of Adults after they have been long expoſed to the Weather, or after they are burnt; and in ſome morbid Caſes, we can divide the firmeſt Bones into

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(*a*) *Malpigh.* Anat. Plant. & oper. poſthum.

to *Plates*, and can obſerve the Fibres of each.

Theſe Plates are ſaid by *Gagliardi* (*a*) to be firmly joined to each other by the Means of a great Number of *Claviculi*, or ſmall bony Proceſſes, which riſing from the interior *Lamellæ*, pierce thro' ſome, and are fixed into others of the more external Plates. He has deſcribed and painted four different Species of theſe bony Nails, *viz. the perpendicular*, *oblique*, *beaded* and *crooked.* He likewiſe endeavours to account for their Formation, and to ſhew how well they are fitted for uniting the Plates of Bones without any Inconvenience.

*Gagliardi*'s Account of the *Claviculi* may poſſibly be true; but in Bones prepared as he directs, I could never ſee more than numerous irregular Proceſſes riſing out from the Plates; and the accurate Diſcoverer of the minute Structure of Animals, *Malpigius* (*b*), thinks theſe nothing elſe than ſome few of the bony Fibres riſing perpendicularly, while the greateſt Number run horizontally, and denies them to have any ſuch regular Appearance, as *Gagliardi* deſcribes.

Though the exterior Part of Bones is compoſed of firm compact Plates, yet they are all more or leſs cavernous internally. In ſome (*e. g.* middle thin Part of the *Scapula* and *Os ilium*) the ſolid Sides are brought ſo near, that little Cavity can be ſeen, and in others (middle of *Os Humeri*, *Femoris*, &c.) the Cavities are ſo large, that ſuch Bones are generally eſteemed to be fiſtular, or hollow Pipes. But the internal ſpongy Texture of the former Claſs is evident

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(*a*) Anat. oſſium nov. invent. illuſtrat. cap. 1. Obſ. 2.

(*b*) Oper. poſthum.

evident in young Animals, and ſome of it may be ſeen to remain in thoſe of greateſt Age. And when the latter kind of Bones are cautiouſly opened, after they have been kept ſo long as to be free of the Oil they contain, or after being burnt, ſmall interlaced bony Fibres may be obſerved in thoſe Places which are thought to be altogether fiſtular.

This ſpongy cavernous internal Part of Bones is generally called their *Cancelli* or LATTICE-WORK, and is formed in the following Manner. The Plates are firmly joined about the middle of the Bone; but as they are extended towards its Extremities, the more internal Plates ſeparate from the exterior, and ſtretch out their Fibres towards the Axis of the Bone, where they are interwoven with the Fibres of other Plates that have been ſent off in the ſame Way; and ſeeing the Plates are thus conſtantly going off in their Courſe towards the Extremities; the ſolid Sides of the Bone muſt become thinner proportionally, and the Lattice-work muſt be thicker and ſtronger. This is ſeen evidently in ſome Bones, where the ſolid Sides of their middle is very thick, and the *Cancelli* are ſcarce obſervable; whereas at their Extremities, where their Diameter is greateſt, the ſolid Walls or Sides are not thicker than Paper, and the *Cancelli* are numerous and large enough to fill up the whole Space left between the Sides.

The Twiſting and Windings which theſe *Cancelli* make, and the Interſtices which they leave, differ conſiderably in Figure, Number and Size, and therefore form little Cells, which are as different, but communicate with each other. *Gagliardi* (*a*) minutely remarks theſe different Appearances of the *Cancelli*, after they begin to ſeparate from the Plates, and from thence diſtinguiſhes them into *Cancelli corrugati* or wrinkled, *cribriformes* or perforated and *reticulares* or Net-like.

The *Cancelli* ſuſtain the membranous Bags of the Marrow which are ſtretched upon them, and thereby hinder theſe membranous Parts to be torn or removed out of their proper Places in the violent Motions and different Poſtures which the Bones are employed in, or in the ſeveral Degrees of Diſtention which the Bags are brought to, by the Increaſe or Decreaſe of the Quantity of Marrow. This Support which the *Cancelli* afford the Marrow, alſo ſaves the Membranes and Veſſels of this Subſtance, in the lower Parts of the Bones, from being compreſſed by the Weight of the Marrow in their middle and ſuperior Parts, which would make a conſiderable Preſſure in the long perpendicular Bones.

The Depreſſions between the Fibres of the exterior Plates of Bones appear like ſo many Furrows on their Surface, into each of which the *Perioſteum* enters, by which the Surface of Contact between it and the Bone is conſiderably increaſed, and a greater Number of Veſſels is ſent from it into the Bone. On both theſe Accounts their Adheſion is ſtronger than it would be, if there was leſs Surface of Contact and fewer Veſſels.

Both on the Ridges and Furrows, numerous little Pits or Orifices of Canals are to be ſeen, by

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(*a*) Anat oſſium, cap. 1. Obſ. 4, 5, 6, 7.

by which the Veſſels paſs to and from the Bones.

After a ſucceſsful Injection, the Arteries can be traced in their Courſe, from the Pits to the Plates and Fibres; and in ſawing, cutting or raſping the Bones of living Creatures, theſe Veſſels diſcover themſelves by the ſmall Drops of Blood which then ouze out from the moſt ſolid Part of Bones. But the cleareſt Demonſtration of the intimate Diſtribution of theſe ſmall Arteries, is, to obſerve the Effect of ſuch a tinging Subſtance as can retain its Colour, when ſwallowed, digeſted and mixed with the Blood of any living Animal, and at the ſame Time has Particles ſmall enough to be conveyed into the Veſſels of the Bones, ſuch is *Rubia tinctorum*, Madder-root (*a*); for we ſee the gradual Advances which this Tincture makes from the *Perioſteum* into the more internal Parts of the Bones, and how univerſally the Diſtribution of the Liquors is made, the whole bony Subſtance being tinged. Whether the Time which this tinging Liquor takes to paſs from the outer to the internal Plates, till all are made of its Colour, and the Time which the diſappearing of the Dye, after giving the Creature no more of this ſort of Food, makes us think it takes to return, are the ſame which the natural Liquors take to circulate, is uncertain; becauſe this tinging Subſtance may not be ſo fit for circulating in the Veſſels, as the natural Liquors are.—— The Arteries of the Bones are larger near each Extremity than at the middle of the larger Bones that are much moved

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(*a*) Philoſ. Tranſact. Num. 442. Art. 8. Num. 443. Art. 2. Num. 457. Art. 4. Mem. de l'Acad. des Sciences 1739, 1743.

moved, becauſe they not only ſerve the bony Plates, near the Extremities, but paſs through them to the Marrow.—— As Animals advance in Age, the Arteries of the Bones become leſs capacious, as is evident; 1. From the Bones of Adults having leſs Blood in them, than thoſe of Children have. 2. From their becoming incapable in old Age of admitting the colouring Powders uſed in Injections, which eaſily paſs in Youth. And, 3. From the Bones of old Creatures being more difficultly tinged with Madder than thoſe of young ones.—— If Authors have not miſtaken, the Arteries of Bones have ſometimes become very large. *Diemerbroeck* (*a*) relates an Obſervation of an Artery in the anterior middle Part of a carious *Tibia*, the Pulſation of which he ſaw evidently for ſome Days; and *Mery* (*b*) demonſtrated to the Royal Academy at *Paris*, a large Artery paſſing through a ſolid hard Bone.

Since the Veins of the *Perioſteum* cannot be filled with a coloured Injection, we are not to expect that their Branches, the Veins of the Bones, ſhould; and they are too ſmall to be ſeen diſtinctly without ſuch Aſſiſtance; but we may conclude from Arteries being accompanied with Veins ſo far as we can trace them in every other Part of the Body, that there are alſo Veins in the Bones; and the diſappearing of the Tincture of *Madder* could not be without them.

The Bones of a living Animal are ſo inſenſible, that they can be cut, raſped, or burnt, without putting the Creature to Pain, and their Nerves

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(*a*) Anat. lib. 9. cap. 1.
(*b*) Hiſt. de l'Acad. des Sciences 1704.

Nerves cannot be ſhewn by Diſſection; from which it might be inferred that they have no Nerves diſtributed to them; but the general Tenor of Nature, which beſtows Nerves to all the other Parts, ſhould prevent our drawing ſuch a Concluſion: And if Senſibility is a ſure Proof of Nerves entring into the Compoſition of any Part, as it is generally allowed to be, we have ſufficient Evidence of Nerves here in the Bones; for the granulated red Fleſh which ſprouts out from them, after an Amputation of a Limb, or performing the Operation of the *Trepan*, or after an *Exfoliation*, is exquiſitely ſenſible: And in ſome Ulcers of Bones, where the *Perioſteum* was all ſeparated, the Patient ſuffered racking Pain, if the Bone was touched with a rough Inſtrument; nor was he free of Pain after the Bone was perforated (*a*). The Reaſon why the Nerves of rigid hard Bones become inſenſible, is, That all Nerves muſt have a conſiderable Degree of Flexibility at the Part where Objects are applied, otherwiſe they cannot be affected by the Impreſſions of Objects. We ſee this illuſtrated in a very common analogous Caſe, the Growth of a new Nail, when the former one has ſuppurated off, the thin Membrane which firſt appears, is exquiſitely ſenſible, but gradually becomes dull in its Senſation, till it can be cut or ſcraped without cauſing Pain, when it is formed into a hard Nail.

From what has been ſaid of the Veſſels of Bones, it is evident that there is a conſtant Circulation of Fluids in every Part of them, and that

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(*a*) Nicol Maſſa lib. introd. Anat. cap. 30.

that there is a perpetual Waſte and Renewal of the Particles which compoſe the ſolid Fibres of Bones, as well as in other Parts of the Body; the Addition from the Fluids exceeding the Waſte during the Growth of the Bones, the Renewal and Waſte keeping pretty near *par* in adult middle Age, and the Waſte exceeding the Supply from the Liquors in old Age, as is demonſtrable from their Weight: For each Bone increaſes in Weight as a Perſon approaches to Maturity, continues of nearly the ſame Weight till old Age begins, and then becomes lighter. The ſpecifick Gravity of the ſolid Sides, on the contrary, increaſes by Age; for then they become more hard, compact and denſe. In conſequence of this the Bones of old People are thinner and firmer in their Sides, and have larger Cavities than thoſe of young Perſons.

This vaſcular Texture of Bones muſt make them ſubject to *Obſtructions*, *Ecchymoſes*, *Ulcers*, *Gangrenes*, and moſt other Diſeaſes which the ſofter Parts are affected with; and therefore there may be a greater Variety of *Caries* than is commonly deſcribed (*a*).

Hence we can account for the following Appearances,

*Hæmorrhagies* from fungous Fleſh riſing out from the moſt ſolid Part of a cut Bone (*b*).

The regular alternate Elevation and ſubſiding or apparent Pulſation ſo frequently to be ſeen in ſome of the Cells of a carious Bone.

Cells reſembling *Cancelli*, ſometimes ſeen in the

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(*a*) Edinburgh Medical Eſſays and Obſ. Vol. V. Art. 24.
(*b*) Medical Eſſays, Vol. IV. Art. 21.

the Part of a Bone, which in a natural State is the moſt ſolid and firm (*a*).

A Bone as a Tube including another Bone within it (*b*).

Viewing the internal Surface of the ſolid Parts of Bones, we ſee the Orifices of Canals, which paſs outwards through the Plates to open into other Canals that are in a longitudinal Direction, from which other *tranſverſe* Paſſages go out to terminate in other *longitudinal* Canals, and this Structure is continued thro' the whole Subſtance of the Bone, both theſe kinds of Canals becoming ſmaller gradually as they approach its outer Surface.—Theſe Canals are to be ſeen to the beſt Advantage in a Bone burnt till it is white; when it is broken tranſverſely, the Orifices of the *longitudinal* Canals are in View; and when we ſeparate the Plates, the *tranſverſe* ones are to be obſerved. Here however we are in danger of believing both theſe Sorts of Canals more numerous than they really are, becauſe, as *Morgagni* (*c*) has remarked, the Holes made by the tranſverſe Proceſſes connecting the Plates of the Bone, will have the Appearance of the *tranſverſe*, and the Paſſages for the Blood-veſſels reſemble the *longitudinal* Canals. I don't know how we are to keep free of Error about the *tranſverſe* Canals, but think we may diſtinguiſh between the two kinds of *longitudinal* ones; for the Paſſages of the Veſſels are largeſt near the external Surface of the Bone, and every tranſverſe Section of them is circular; whereas the *longitudinal Canals* are largeſt

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(*a*) Ruyſch, Theſ. 8. Num. 8. Theſ. 10. Num. 176.
(*b*) Idem, Theſ. 10. Num. 176.
(*c*) Adverſ. 2. Animad. 25.

largeſt near the *Cancelli*, and their tranſverſe Sections appear to me to be of a flat oval Figure, which may be owing to the different *Momentum* of the Fluids conveyed in them.—The Situation of the larger longitudinal Canals, and of the Paſſages of the larger Veſſels, makes a Bone appear more denſe and compact in the middle of its ſolid Sides, than towards its outer and inner Surfaces, where it is ſpongy.

We ſee Marrow contained in the larger tranſverſe and longitudinal Canals juſt now deſcribed, and from thence judge that it paſſes alſo into the ſmaller ones. The Drops of Oil which we diſcover with a Microſcope every where on the Surface of the tranſverſe Fracture of a recent Bone, and the ouſing of Oil thro' the moſt ſolid Bones of a Skeleton, which renders them greaſy and yellow, are a Confirmation of the Uſe of theſe Canals. Of what Advantage this Diſtribution of the Marrow through the Subſtance of Bones is, will be pointed out, after the Nature of this animal Oil has been inquired into.

Moſt Bones have one or more large oblique Canals formed through their Sides for the Paſſage of the medullary Veſſels, which are to be deſcribed afterwards.

The Bones, when expoſed to a ſtrong Fire in Chemical Veſſels, are reſolved in the ſame manner as the other Parts of Animals, into *Phlegm*, *Spirit*, *volatile Salt*, *fetid Oil*, and a black *Caput mortuum*, which laſt calcin'd in an open Fire, has its more fixed Oil, to which the black Colour was owing, forced away, and a white Earth is left that has no Mixture of fixed Salt in it; on which Account theſe Aſhes are the moſt proper Materials for forming into Veſſels, that are to undergo the greateſt Force of Fire, being ſcarce capable of vitrifying, which other Subſtances are very liable to. This Earth would ſeem to be the proper conſtituent ſolid Part of Bones; for the Quantity of it is great; greater, ſays *Havers* (*a*), than of all the other Principles taken together; and after all the others are ſeparated from a Bone, its former Shape ſtill remains, tho' it becomes ſo brittle as to moulder into Duſt on the leaſt Touch; and when moiſtned with a little Water or Oil, it recovers ſome Degree of Tenacity, but can never be reſtored to its former Firmneſs; ſince it is not poſſible by any Art to reduce Bones to their natural State, when once they are changed, and have their ſeveral Principles ſeparated by a chemical *Analyſis*.

Seeing therefore the Solidities of Bones increaſe by Age, and the Proportion of Earth to the other Principles becomes greater, while ſome of theſe degenerate from their former State, we may ſee one Reaſon why the Bones of old People are more brittle than thoſe of young.

The Bones ſerve to ſuſtain and defend the other ſofter, leſs firm, and leſs ſolid Parts.

The Bones are lined within, as well as covered externally with a fine Membrane, which is therefore commonly called PERIOSTEUM INTERNUM.

This *Perioſteum* is an extremely fine Membrane, nay in ſeveral Bones it has a looſe reticular Texture; and therefore it is compared by

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(*a*) Oſteolog. nov. Diſc. I.

by ſome to the *Arachnoid* Coat of the ſpinal Marrow; ſo that we cannot expect to divide it into Layers, as we can divide the *external Perioſteum*. We can however obſerve its Proceſſes entring into the tranſverſe Pores of the Bones, where they probably are continued to form the immediate Canals for the Marrow diſtributed through the Subſtance of the Bones. Probably too, *Winſlow* (*a*) may be right in thinking, that along with theſe Proceſſes of this Membrane, Veſſels are ſent, as from the external *Perioſteum*, into the Bone; but they are not ſo large as that I could ever make an Injection enter them, nor could I ſee them any other Way. Theſe Proceſſes being of a very delicate Texture, the Adheſion of this Membrane to the Bone is ſmall; ſo that it ſeparates commonly more eaſily from the Bone than from the Marrow it contains; wherefore one might call it the common Membrane of the Marrow, rather than by the Name it now has. But whether one or t'other Deſignation ought be given it, is not worthy a Diſpute.

From the internal Surface of the internal *Perioſteum*, a great Number of thin Membranes are produced, which paſſing a-croſs the Cavity, unite with others of the ſame kind, and form ſo many diſtinct Bags, which communicate with each other; and theſe again are ſubdivided into communicating veſicular Cells, in which the Marrow is contained. Hence it is, that the Marrow, when hardned and viewed with a Microſcope, appears like a Cluſter of ſmall Pearl; and that the hardned Marrow of

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(*a*) Expoſition anat. des Os frais, ſect. 82, 83.

of Bones buried ſeveral Years under Ground, and examined by *Ruyſch* (*a*), is granulous, or compoſed of very ſmall Grains, as I have likewiſe frequently ſeen it in Bones laid ſome time in Water, and then expoſed to the Air to dry. This Texture is much the ſame with what obtains in the other cellular Parts of the Body, where Fat is collected, only that the Cells containing the Marrow are ſmaller than thoſe of the *Tunica adipoſa* or *celluloſa* elſewhere, which probably is owing to their being incloſed in the Bones, where they are not ſtretched or extended as in other Parts of the Body.

The MARROW is the oily Part of the Blood, ſeparated by ſmall Arteries, and depoſited into theſe Cells: Any red Colour it ſeems to have in ſome Parts, is owing to the Blood-veſſels on the Cells containing it, being larger and more numerous at theſe Places.

Beſides the Arteries which I mentioned already, *p.* 10. to be ſent from the Bones to the Marrow, there is at leaſt one Artery for each Bone; ſeveral Bones have more, whoſe principal Uſe is to convey and ſecern this oily Matter. After theſe Arteries have pierced the ſolid Side of a Bone, they are divided into ſeveral Branches, which ſoon are diſtributed every where on the internal *Perioſteum*, and afterwards ſpread their Branches on the medullary Cells.

The Blood, which remains after the Secretion of the Marrow, is returned by proper Veins, which are collected from the Membranes into one or two large Trunks, to paſs out at the ſame

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(*a*) Theſaur. 9. Num. 2. & Adverſ. Dec. III. Obſ. 9.

ſame ſlanting oblique Holes or Paſſages at which the Artery or Arteries enter.

The Trunks of theſe medullary Veſſels inlarge as the Creature turns older, but the ſmall Branches become ſmaller, as is evident from Injections which cannot be made to paſs near ſo far in the Veſſels of Adults as of Children, and on this the different Appearances of the Marrow depend: it is bloody in Children, oily and balmy in middle Age, and thin and watery in old People. Is it not univerſally true that the ſmall Veſſels of Animals are decreaſing in their Capacities at leaſt after Birth? Are not many Phænomena of the animal Oeconomy depending on this Change in the Veſſels?

We can trace the Nerves a good Way in their Diviſion on the Membrane of the Marrow along with the Blood Veſſels, but their minute Ramifications proper to the particular Cells, are too ſmall for us to diſſect. By the Experiments however of *Du Verney* (*a*) on Men and Brutes, which I have likewiſe made, the Senſibility of theſe Membranes, and conſequently their being ſupplied with nervous Filaments, is ſufficiently proved; the racking Pain with which Suppurations within Bones are frequently attended, fully prove that the Membranes are exquiſitely ſenſible: So that *Hippocrates* (*b*) might ſay very reaſonably and juſtly, that a Wound penetrating into the Cavity of a Bone would produce a *Delirium*.

The Arteries, Veins and Nerves of the Marrow,

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(*a*) Memoires de l'Acad. des Sciences, 1700.
(*b*) Aphoriſm. ſect. 7. Aph. 24.

row, wrapt up in one common Coat, from the *Perioſteum*, paſs through the Bones by proper Channels, the moſt conſiderable of which are about the middle of each Bone, and are, eſpecially in the human Body, very oblique: Sometimes theſe Veſſels continue at a little Diſtance in their Paſſage, when the bony Canal is divided by a ſmall bony Partition or two.

The Marrow is of very conſiderable Uſe to the Bones; for by entring their tranſverſe Canals, and paſſing from them into the longitudinal ones, it is communicated to all the Plates, to ſoften and preſerve them from turning too brittle; and conſequently the Bones are kept ſtronger to reſiſt Injuries. How far this Oil contributes to the Firmneſs of the Bones, is ſufficiently demonſtrated, by obſerving their Brittleneſs, when it is conſumed, or loſes its oily Conſiſtence, as in ſcorbutick pocky Patients, in old People, or in ſuch Bones as have been deprived of this Oil by Fire or Weather.

Beſides this Advantage which the Subſtance of the Bones has from the Marrow, their Articulations are ſaid (*a*) to receive no leſs Benefit; for there are ſeveral Holes near the large Joints, which communicate with the medullary Cells, and tranſmit the Oil to the Articulations, as is plain from the Marrow found often congealed in theſe Pores of fatted Beaſts. In this Way then, all the Parts concerned in the Motion of the Joint will be lubricated; and when the Mucilage ſecreted here, and to be afterwards deſcribed

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(*a*) Joan. de Muralto vade mecum Anat. Exercit. V. Havers Oſteolog. nov.

ſcribed, is incorporated with the Oil, one of the moſt effectual Mixtures is formed for ſuch an Uſe. The Quantity of this Liquor ſupplied to the Articulations, is always in proportion to the Quantity of Motion performed by the Joints; and hence by Exerciſe or Labour, the Quantity of Marrow is diminiſhed; ſo that Butchers can tell, by looking at the Bones of ſlaughter'd Cows, whether they have lately come off a Journey, or have been fed ſometime in the Neighbourhood.

When the Marrow, after having ſerved the Uſes mentioned, is reaſſumed into the Maſs of the Blood, (as it is continually, in common with all the other ſecreted Liquors that have not Paſſages formed for conveying them out of the Body,) it corrects the too great Acrimony communicated to the ſaline Particles of our Fluids, by their Circulation and Heat; in the ſame Manner as the lixivial Salts are blunted by Oil in making Soap. Hence in acute Diſeaſes, the Marrow, as well as the other Fat of the Body, is quickly waſted.

As the Nature of all Oil is to become thin and rancid, when expoſed long to Heat, we may thence, and from the Structure of the Bones, ſee why ſuch an ungrateful Smell, and black thin *Ichor* proceed from corrupted Bones, rather than from any other Part of the Body; and can underſtand the Reaſon of the Changes of Colour which Bones undergo, according to their different Degrees of Mortification.— Hence likewiſe we may learn the Cauſe of a *Spina ventoſa*, and of the Difficulty of curing ſuch *Caries* of Bones as proceed from an Obſtruction, and conſequent Putrefaction of the Marrow; and of a quick Pulſe, Thirſt, and *hectic Paroxyſms*, ſo often attending theſe Diſeaſes in the Bones.—— And from theſe *Phænomena* we may deduce the Reaſon of the fatal *Prognoſis* taken from black fetid Urine in Fevers.

Tho' the Bones ſo far agree in their Structure and annexed Parts, yet we may obſerve a conſiderable Difference among them in their Magnitude, Figure, Situation, Subſtance, Connexion, Uſes, &c. From which Authors have taken Occaſion to diſtinguiſh them into as many Claſſes as they could enumerate of theſe different Circumſtances. But theſe being ſo obvious to every Perſon that looks on Bones, I ſhall content myſelf with mentioning only one of them; which, as it is at firſt Sight very remarkable, ſo it comprehends very near the whole Bones of the Body, and at the ſame Time leads us to examine the moſt conſiderable Variety that is to be found in the Diſpoſition of their conſtituent Parts, and in their Uſes. It is this, That ſome Bones are broad and flat, while others are long and round.

The *broad* Bones have thin Sides, by the Plates being ſoon and equally ſent off to form the *Cancelli*; and this Lattice-work is thicker, and near of an equal Form all through. By this Structure they are well adapted to their Uſes, of affording a large enough Surface for the Muſcles to riſe from, and move upon, and of defending ſufficiently the Parts which they incloſe.

The *round* Bones have thick ſtrong Walls in the Middle, and become very thin towards their Ends; which is owing to very few Plates ſeparating at their Middle, where on that

Account the *Cancelli* are ſo fine and ſmall, that they are not taken notice of: But ſuch Bones are ſaid to have a large Reſervoire of Oil in this Place. Towards their Extremities the Lattice-work becomes very thick, and rather more complete than in the other ſort of Bones. Theſe round Bones having ſtrong Forces naturally applied to them, and being otherwiſe expoſed to violent Injuries, have need of a cylindrical Figure to reſiſt external Preſſure, and of a conſiderable Quantity of Oil to preſerve them from becoming too brittle. Beſides which they are advantageouſly provided with thick Sides towards their Middle, where the greateſt Forces are applied to injure them; while their Hollowneſs increaſes their Diameter, and conſequently their Strength to reſiſt Forces applied to break them tranſverſely, as has been demonſtrated by *Galilæus (a)*. Thus, for inſtance, in eſtimating the proportional Reſiſtance of two cylindrical Bones of unequal Diameters, but conſiſting of an equal Number of ſimilar Fibres uniformly diſpoſed round each, it is plain:

1. That the abſolute Force of theſe two Bones is equal, becauſe they conſiſt of equal Numbers of ſimilar Fibres.

2. That the abſolute Forces of all the Fibres in each Bone will have the ſame Effect in reſiſting any Power applied to break them, as if the Sum of all their Forces was united in the reſpective Centers of the tranſverſe Sections where the Fractures are to be made. For by Hypotheſis the Fibres being uniformly diſpoſed in

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(*a*) Mechanic. Dialog. 2.

in each, there is not any Fibre in either Bone that has not a correſponding Fibre, the Sum of both whoſe Diſtances from the Axis of Revolution (about which all the Parts of the Bone muſt revolve in breaking) is equal to two Semi-diameters of the Bone: Conſequently each Fibre, and all the Fibres, may be regarded as reſiſting at the Diſtance of one Semi-diameter or *Radius* from this Axis, that is, in the Center.

3. Since the united Force of all the Fibres is to be regarded as reſiſting at a Diſtance from the Center of Motion equal to the Semi-diamter, it follows that the total Reſiſtance of all theſe Fibres, or the Strength of the Bone will be proportional to its Semi-diameter, and conſequently to its Diameter.

I have here taken for an Example one of the moſt ſimple Caſes for calculating the proportional Force of Bones; but was it not too foreign to the preſent Deſign, it might be univerſally demonſtrated, that of whatever Figure Bones are, and in whatever Manner their Fibres are diſpoſed, their Strength muſt always be in a *Ratio*, compounded of the Area of their tranſverſe Sections, or of their Quantity of bony Matter, and of the Diſtance of the Center of Gravity of theſe Sections from the Center of Motion, or Fulcrum, on which the Bone is ſuppoſed to be broken *.

Since therefore the Strength of Bones depends on their Number of Fibres or Quantity of Matter, and the Largeneſs of their Diameters,

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* See the Demonſtration of this Theorem by Dr. *Porterfield* in the *Edinburgh Medical Eſſays*, Vol. 1. Art. 10.

ters, one may conclude, that the Part of a Bone formerly fractured, and reunited by a *Callus*, muſt be ſtronger than it was before the Fracture happened; becauſe both theſe Advantages are obtained by a *Callus*: Which is a wiſe Proviſion, ſince Bones are never ſet in ſuch a good Direction as they were naturally of; and then wherever a *Callus* is formed, there is ſuch an Obſtruction of the Veſſels, that if the Bone was again broke in the ſame Place, the *oſſifick* Matter could not ſo eaſily be conveyed to reunite it. This *Callus* may indeed, for want of Compreſſion, be allowed to form into a ſpungy cellular Subſtance, as *Ruyſch* (*a*) ſays he has ſometimes ſeen it; but even in this Caſe the Strength of the Bone at this Part would be ſtill increaſed by one or both the Cauſes abovementioned.

Many Bones have Protuberances or *Proceſſes* † riſing out from them. If a *Proceſs* ſtands out in a roundiſh Ball, 'tis called *Caput* or *Head*.—— If the Head is flatned, it obtains the Appellation of *Condyle*.—— A rough unequal Protuberance is called *Tuberoſity*.—— When a *Proceſs* riſes narrow, and then becomes large, the narrow or ſmall Part is called *Cervix* or *Neck*.—— Long Ridges of Bones are called *Spines*.—— Such *Proceſſes* as terminate in a ſharp Point, have the general Name of *Coronæ* ‡ or *Coronoid* beſtowed on them, tho' for the moſt

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(*a*) Theſaur 8. n. 49. Muſ. Anat. Thec. B. Repoſit. 2. n. 2.

† Ἀπόφυσεις, ἔκφυσεις, ἐξοχὴ, προβολὴ, πρόβλημα, Exceſſus, Explantatio, Tuberculum, Gibbus, Eminentia, Productio, Extuberantia, Projectura, Enaſcentia.

‡ Roſtra, Glandes,

Part they receive particular Names from the Reſemblance they have, or are imagined to have to other Subſtances, *e.g. Maſtoid*, *Styloid*, *Anchoroid*, *Coracoid*, *Spinal*, *&c.*—— Such Proceſſes as form Brims of Cavities are called *Supercilia* *.

Proceſſes ſerve for the advantageous Origin and Inſertion of Muſcles, and render the Articulations firmer and more ſtable.

Before leaving this Subject we muſt remark, that much the greater Number of what are called Proceſſes in adult Bones, diſcover themſelves in Children to be *Epiphyſes* or diſtinct Bones, to be affixed afterwards; as the *Styloid* Proceſſes of the temporal Bones, Proceſſes of the *Vertebræ*, *Trochanters* of the Thigh, *&c.* However, as I deſign to inſiſt chiefly on the Deſcription of the adult Skeleton, in which the Union of theſe Parts is ſo very intimate, that ſcarce any Veſtige remains of their former Separation, I ſhall retain the common Appellation of *Apophyſe* or Proceſs to all ſuch Protuberances; but ſhall remark the principal ones that have no juſt Title to this Name, when they occur in the Deſcription of particular Bones.

On the Surfaces of a great many of the Bones, there are Cavities or Depreſſions: If theſe are deep, with large Brims, Authors name them *Cotylæ* †.——If they are ſuperficial, they obtain the Deſignation of *Glenæ* or *Glenoid*. Theſe general *Claſſes* are again divided into particular *Species*:—— Of which *Pits* are ſmall roundiſh Channels ſunk perpendicularly into the Bone.—— *Furrows* are long narrow Canals formed in the

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* Ἴτυες, ὄφρυες, ἄμβονες, χείλη, Labra.

† Κοτυλίδες, ὀξυβάφοι, Acetabula, Pixides, Buccellæ.

Surface;—— *Nitches* or *Notches*, ſmall Breaches in the Bone;—— *Sinuoſities*, broad but ſuperficial Depreſſions without Brims;—— *Foſſæ*, large deep Cavities which are not equally ſurrounded by high Brims;—— *Sinuſes*, large Cavities within the Subſtance of the Bones, with ſmall Apertures;—— *Foramina* or Holes, Canals that pierce quite thro' the Subſtance of the Bones.——When this laſt Sort of Cavity is extended any long Way within a Bone, the middle Part retains the Name of *Canal*, and its Extremities are called *Holes*.

The Uſes of the Cavities are very numerous; ſuch as, to allow the Heads of the Bones to play in, to lodge and defend other ſofter Parts, to afford a ſafe Paſſage for Veſſels, Muſcles, *&c.* To mention more would engage us too much in the Hiſtory of particular Bones, which more properly belongs to the Demonſtration of the *Skeleton*, where we ſhall have occaſion to obſerve theſe ſeveral Species of Cavities.

To far the greater Number of Bones, whoſe Extremities are not joined to other Bones by an immoveable Articulation, there are ſmaller ones annexed, which afterwards become ſcarce diſtinguiſhable from the Subſtance of the Bone itſelf. Theſe are called *Epiphyſes* or *Appendices*[*]. Some Bones have one, others have two, three or four of theſe *Appendices* annexed, by the means of Cartilages which are of a conſiderable Thickneſs in Children, but by Age become thinner, the Oſſification proceeding from the Extremity of the Bone on one Side, and from the *Epiphyſes* on the other, till at laſt,

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[*] Applantatio, Additamentum, Adnaſcentia, Adnexum, Perone.

in Adults, the Place of their Conjunction can ſcarce be ſeen on the external Surface: And, as *Winſlow* (*a*) obſerves, it is only ſometimes that we can then ſee any Mark of Diſtinction in the *Cancelli*.

We may here obſerve with *Veſalius* (*b*), That ſeveral Proceſſes (*e. g. Trohanters* of the Thigh, *Spine* of the *Scapula*, &c.) have *Epiphyſes*, and that Proceſſes frequently riſe out from *Epiphyſes*, for Example, at the lower End of the *Femur*, *Ulna*, *Tibia*, &c.

The *Epiphyſes* are united chiefly to ſuch Bones as are deſtin'd for frequent and violent Motion; and for this Purpoſe they are wiſely framed of a larger Diameter than the Bone they belong to; for by this means the Surface of Contact between the two Bones of any Articulation being increaſed, their Conjunction becomes firmer, and the Muſcles inſerted into them act with greater Force, by reaſon of their Axes being further removed from the Center of Motion. Theſe Advantages might indeed have been obtained by the Expanſion of the Extremity of the Bone itſelf to a Thickneſs equal to that of the *Epiphyſes*; but then the conſtant Separation of new Plates to form ſo wide a cellular Structure, muſt have left the ſolid Sides of the Bones ſo thin, as to yield eaſily, either to the Action of the Muſcles fixed to them and paſſing over them, to the Weight ſeveral of them are obliged to ſupport, or to the Application of any other external Force.

Beſides theſe Uſes, the *Epiphyſes* ſerve other Pur-

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(*a*) Expoſition Anatomique de Corps Humain. Traité des Os ſecs, ſect. 116.

(*b*) De human. Corp. fabrica, lib. 1. cap. 3.

Purpoſes; ſuch as, ſecuring the Ligaments of the Articulations which riſe out from between the Bones and them; for as ſoon as theſe Parts are intimately joined, the Ligaments inſinuated betwixt them muſt have a much ſtronger Connection than they could have to the ſmooth Surface of the Bones, as *Columbus* (a) and *Fallopius* (b) have remarked. And then the *Epiphyſes* hinder the Fibres of the Bone to run out too far, and to join with its neighbouring Bone, which would deprive us of all Motion, while the Fibres of the *Epiphyſes*, which ſeem not ſo much diſpoſed in a ſtreight Direction, are prevented from the like Inconvenience, by the Interpoſition of Cartilages. That we ſhould be liable to ſuch an Inconvenience without this Mechaniſm, is evident from the Obſervations of the bony Proceſſes, which jutt out preternaturally from Bones when the *Perioſteum* is deſtroyed, and the Bones are not reſtrained in their Growth; and from the Lameneſs which happens ſo frequently after the Eroſion of the Cartilages, when the Fibres of two Bones deſigned for Motion run one into another, which is the worſt Species of *Anchyloſis*, as every Day happens in Wounds of the Joints, and in Ulcers from the *Paidarthrocace*, *Scrophula* and *Spina ventoſa*. The ſame Diſeaſe likewiſe frequently follows the Oſſification of theſe Griſtles, from old Age, or any other Cauſe. Two very remarkable Inſtances of an univerſal *Anchyloſis* are related by

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(a) De re Anatomica, lib. 1. cap. 2.

(b) Expoſit. de oſſibus, cap. 11.

*Columbus* (*a*) and *Deſlandes* (*b*): The firſt Author ſays, he ſaw a Skeleton whoſe Bones from the Head to the laſt Joints of the Toes were all immoveably united; and the other gives the Hiſtory of a Child near two Years old, that had not a moveable Joint.

However ſolid and compact adult Bones are, yet they were once Cartilages, Membranes, nay a mere Gelly. This needs no further Proof, than repeated Obſervations of *Embryos* when diſſected: And how much more tender muſt the Bones be before that Time, when neither Knife nor Eye is capable to diſcover the leaſt Rudiments of them? By Degrees they become more ſolid, then aſſume the Nature of Griſtles, and at laſt oſſify. The Coheſion of their Plates and Fibres always increaſing in Proportion to their increaſed Solidities, as is evident from the Time neceſſary to unravel the Texture of Bones of People of different Ages, or of denſe and of ſpongy Bones, or of the different Parts of the ſame Bone, and from the more tedious Exfoliations of the Bones of Adults than of Children.

The Induration of Bones is chiefly owing to their being expoſed more than any other Parts to the ſtrong Preſſure of the great Weights they ſupport, to the violent Contraction of the Muſcles fixed to them, and to the Force of the Parts they contain, which endeavour to make Way for their own further Growth. By all this preſſing Force the ſolid Fibres and Veſſels of the Bones are thruſt cloſer, and ſuch Particles

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(*a*) De re Anatomica, lib. 15.
(*b*) Hiſtoire de l'Acad. des Sciences 1716.

ticles of the Fluids conveyed in theſe Veſſels as are fit to be united to the Fibres, are ſooner and more firmly incorporated with them, while the remaining Fluids are forcibly driven out by the Veins to be mixed with the Maſs of Blood. In conſequence of this, the Veſſels gradually diminiſh as the Bones harden. From which again we can underſtand one Reaſon, why the Bones of young Creatures ſooner reunite after a Fracture, than thoſe of old, and why Horſes, Bullocks, and other young Creatures of a large Brood, decay in their Size, when put too ſoon to hard Labour.

That the oſſifying of Bones greatly depends on Preſſure, ſeems to be evinced from the frequent Examples we meet with of other Parts turning bony, when long expoſed to the compreſſing Force of the ſurrounding Parts, or when they are ſubjected to the like Circumſtances by their own frequent and violent Contraction. Witneſs the Bones found ſo frequently near the Baſe of the Heart in ſome old Men, and in ſeveral other Creatures. Nay the muſcular Subſtance of the Heart has been oſſified in ſuch (*a*), and the Arteries of old Men often become bony. The Cartilages of the *Larynx* are generally oſſified in Adults. In Beaſts of Burden the Cartilages between the *Vertebræ* of the Back very often change into complete Bones, and being intimately united with the *Vertebræ*, the whole appears one continued Bone. Nor is the *Perioſteum* exempted from ſuch

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(*a*) Cheſelden Anatomy, Book 1. Chap. 1. Garengeot, Hiſt. de l'Acad. des Sciences, 1726.

ſuch an Induration; for *Peyer* (*a*) tells us, he divided this Membrane into ſeveral bony Plates.

To confirm this Argument ſtill further, we may obſerve, That Bones begin their Oſſification at the Places where they are moſt expoſed to theſe Cauſes, *viz.* in the cylindrical Bones from a middle Ring, and in the broad ones, at or near their Center, from one or more diſtinct Points. The Reaſon of which is, That theſe Parts are contiguous to the Bellies of the Muſcles annexed to the Bones, where the ſwelling of theſe moving Powers is greateſt. What the Effects of this may be, let any judge who view ſome of the Bones, as the *Scapula* and *Oſſa Ilium*, which are covered with Muſcles on each Side; how compact and thin they are in Adults, where the Bellies of the Muſcles were lodged, whereas in Children they are thicker. But this being the middle Part of theſe Bones, where the greateſt Number of Fibres is, this particular Place would have been much thicker in Adults, had not this forcible Cauſe been applied, which has not had ſuch Effects in Children, whoſe Muſcles have not been much exerciſed.—— Beſides, if we allow that all the Parts of a Bone are equally increaſed by the conſtant Supply of new Particles, each Fibre, and every Particle of a Fibre, will endeavour to make Way for its own Growth, by puſhing the one next to it; and conſequently by far the greateſt Preſſure will be on the Middle: Wherefore the Particles there will be made moſt firm: And here it is that Bones begin their

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(*a*) Ephemerid. German. Decur. 2. Ann. 7. Obſerv. 205.

eir Oſſification. Laſtly, The Pulſation of e medullary Arteries, which enter the Bones ear to this middle Part, may, as Authors have lledged, contribute perhaps ſomewhat to this nduration.

From the Effects of Preſſure only it is, that ve can account for the Bones of old People aving their Sides ſo much thinner, yet more enſe and ſolid, while the Cavities are ſo much arger than in thoſe of young People; and for the Prints of Muſcles, Veſſels, &c. being ſo much nore ſtrongly marked on the Surfaces of the ormer than of the latter, if they belong to People of near the ſame Condition in Life. Preſſure muſt likewiſe be the Cauſe which in People of equal Ages makes theſe Prints ſtronger in the Bones of thoſe who have had much Labour and Exerciſe, than they are found in People who have led an indolent unactive Life.

It is alſo probable, that Oſſification depends on the Veſſels of the Bones being ſo diſpoſed, and of ſuch Diameters, as to ſeparate a Liquor, which may eaſily, when deprived of its thinner Parts, turn into a bony Subſtance; as ſeems plain from the Obſervation of the callous Matter ſeparated after Fractures and Ulcers, where Part of the Bone is taken out: For in theſe Caſes this Liquor ouzing out from the open Orifices of the broken Veſſels is gradually formed into granulated Fleſh; which extends itſelf ſo as to fill up all the Space where the Bone is taken from, then hardens, till it becomes as firm as any other Part of the Bone. This happens frequently, even when the Ends of the diſeaſed Bone are at a conſiderable Diſtance from each other, as I have ſeen in ſeveral

veral Caſes, and of which there are remarkable Inſtances handed down by Authors. One, ſcarce inferior to any of them, was communicated to me by Mr. *Laing* Surgeon at *Jedburgh*, of a Child, whoſe *Tibia* he took out, leaving little more than the *Epiphyſes* at each Extremity; all of the Bone that he took away was ſupplied by a bony Subſtance, on which his Patient walks eaſily and firmly (*a*).

Perhaps both the Cauſes of Oſſification above-mentioned may be aſſiſted by the Nature of the Climate People leave in, and the Food they uſe. Whence, in hot Countries, the Inhabitants ſooner come to their Height of Stature, than in the northerly cold Regions: And thence ſeems to have ariſen the common Practice among the Ladies of making Puppies drink Brandy or Spirit of Wine, and of bathing them in theſe Liquors, to prevent their growing big. Nay, it has been obſerved, that much Uſe of ſuch Spirits has occaſioned Parts, naturally ſoft, to petrify in ſome, and to oſſify in other People of no great Age. Witneſs the Caſes related by *Littre* (*b*) and *Geoffroy* (*c*).

From the foregoing Account of the Structure of Bones, and of their Oſſification, we may underſtand the Reaſons of the following Phænomena,

How Bones may be ſoftned or diſſolved.

How the natural Colour of the Bones may be

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(*a*) Medical Eſſays and Obſerv. publiſhed at *Edinburgh*, Vol. I. Art. 23.

(*b*) Hiſtoire de l'Acad. des Sciences 1706.

(*c*) Memoires de l'Acad des Sciences 1706.

e changed by ſome Sorts of Food (*a*).

Why the Bones of ſome People are ſo long f hardening, and in others never compleatly ndurate.

Why in ſuch whoſe Oſſification is very ſlow, he Bones are generally thicker in proportion o their Lengths, eſpecially at their Extremities, s in the *Rickets*.

How hard firm Bones have become ſoft and pliable by Diſeaſes (*b*).

How in ſome Caſes the Bones may waſte and diminiſh (*c*).

How the Bones may become ſolid all through, without any Appearance of *Cancelli* (*d*).

Why the *Epiphyſes* ſeparate from the Bones in ſome Diſeaſes (*e*).

How *Nodes*, *Tophi* and *Exoſtoſes* happen after the Eroſion of the external Plates of the Bones in the *Lues Venerea*, *Scurvy*, *Rheumatiſm* and *Gout*.

What occaſions ſometimes ſuch Difficulty in curing fractured Bones, or why they never reunite, tho' they are reduced, and all proper Means

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(*a*) Philoſoph. Tranſact. 442. Art. 8. Num. 443. Art. 2. Num. 457. Art. 4. Mem. de l'Acad. des Sciences 1739. 1742.

(*b*) Hiſtoire de l'Acad. des Sciences 1700. Mem. 1722. Gagliardi Anatom. oſſium, cap. 2. obſerv. 3. Ephem. Gem. Decur. 1. Ann. 1. obſ. 37. & ſchol. Decur. 2. ann. 7. obſ. 212. 235. Decur. 3. ann. 2. obſ. 3.

(*c*) Cheſelden Anat. Book 1. Chap. 1. Hiſt. de l'Acad. des Sciences 1700.

(*d*) Ruyſch Theſaur. 2. Arc. 5. Theſ. 3. Loc. 1. Num. 5. Theſ. 9. Num. 2. not. 3.

(*e*) Memoires de l'Acad. des Sciences 1699. Diemerbroek Anat.. lib. 9. cap. 19.

Means towards a Cure are uſed *(a)*.

Why *Calluſes*, after Fractures, are ſometimes very thick and protuberant.

What Difference there ought to be in the Application of Bandages to Fractures of the Bones of old and of young Patients.

Whoever is deſirous to know, in what Time and Order each Bone and its ſeveral Parts begin to aſſume a bony Nature, let him conſult *Kerckringius* (*b*) who gives us the Delineations of Abortions from three Days after Conception, and traces the Oſſification of the Bones from three Weeks and a Month, till the Time of the Birth: To whom ſhould be added *Coiterus (c)* and *Eyſſonius (d)*. An Account of this Subject might alſo be collected out of *Ruyſch*'s Works, where ſome of the Miſtakes committed by the former Authors are corrected, and ſeveral more Particulars to make the Hiſtory of the *Oſteogenea* more accurate, have ſince been added by *Nesbitt (e)* and *Albinus (f)*.

I muſt refer to the Authors now quoted for the more curious Part of the human Oſteogeny, not having Preparations enough to give ſuch a full Hiſtory of it as is done by them; but I ſhall endeavour to explain the more uſeful and neceſſary Part of the Oſteogeny, by ſubjoining to the Deſcription of each Bone of an Adult, its Condition in ripe Children, that is,

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(*a*) Meck'ren. Obſerv. Medico-Chirurg. Obſ. 71. Ruyſch adverſ. Dec. 2. ſect. 2. Obſerv. Anat. Chir. obſ. 4.

(*b*) Anthropograph. Ichnograph. & Oſteogenea Fœtuum.

(*c*) De oſſibus fœtûs abortivi.

(*d*) De Oſſibus Infant. cognoſcend. & curand.

(*e*) Human Oſteogeny explained.

(*f*) Icones oſſium fœtûs humani accedit oſteogeniæ brevis hiſtoria.

is, in ſuch as are born at the ordinary Time, and ſhall point out what Parts of each are afterwards joined in Form of *Epiphyſes*. This, with the following general Rules, ſeem to me ſufficient for underſtanding what of this Subject is neceſſary in the Practice of Phyſick and Surgery.

1. Wherever I mention any Parts being cartilaginous, or their being ſtill ſeparable from the other Parts of the Bone to which they belong, I would be underſtood to hint, that about ſeven or eight Years of Age, ſuch Parts are oſſified and united to their proper Bones, unleſs when it is ſaid that they are afterwards formed into *Epiphyſes*.

2. Such as become *Epiphyſes*, are generally oſſified at ſeven or eight Years of Age, but being for the moſt Part moiſtned by *Synovia*, their external Surface is ſtill ſomewhat cartilaginous, and they are not yet united to their Bones.

3. At eighteen or twenty Years of Age, the *Epiphyſes* are entirely oſſified, and have blended their Fibres ſo with the Body of the Bone, as to make them inſeparable without Violence.

The Knowledge of this Part of the *Oſteogeny*, which I have undertaken thus to explain, I think neceſſary to prevent dangerous Miſtakes in the Cure of ſeveral Diſeaſes: As for Example, without this Knowledge, the Separation of an *Epiphyſe* might be miſtaken for a Fracture or Luxation.—The Interſtice of two Parts of a Bone not yet joined might be judged to be a Fiſſure,— A *Diaſtaſis*, or other violent Separation of ſuch disjoined Pieces of a Bone, might be thought a great Fracture;—The Protruſion of one Piece, or its overloping any other, could be miſtaken for an Excreſcence or *Exoſtoſis*. Such Errors about the Nature of a Diſeaſe would give one very different Indications of Cure, from what he would have, if he really underſtood his Patient's Caſe. And very often the Knowledge of the different Inequalities on the Surfaces of Bones, muſt direct us in the Execution of what is proper to be done to cure ſeveral Diſeaſes of Bones.

Having thus conſidered the Bones as ſingle, we ought next to ſhew the different Manner of their Conjunctions [‡]. To expreſs theſe, Anatomiſts have contrived a great Number of technical Terms, about the Meaning, Propriety and Claſſing of which there has unluckily been great Variety of Opinions. Some of them it is neceſſary to retain, ſince they ſerve to expreſs the various Circumſtances of the Articulations.

The ARTICULATIONS are moſt commonly divided into three Claſſes, the *Symphyſis*, *Synarthroſis*, and *Diarthroſis*.

The *Symphyſis*, which properly ſignifies the Concretion or growing together of Parts, when uſed to expreſs the Articulations of Bones, does not ſeem to comprehend under the Meaning generally given to it, any thing relating to the Form or Motion of the conjoined Bones, but by it moſt Authors only denote the Bones to be connected by ſome other Subſtance; and as there are different Subſtances which ſerve this Purpoſe, therefore they divide it into the three following Species,

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[‡] *Σύνταξις, σύνθεσις, συμβολὴ, ὁμιλία*, Compoſitio, Connexio, Articulatio, Conjunctio, Nodus, Cummiſſura, Structura, Compages.

1. *Synchondroſis* [†], when a Cartilage is the connecting Subſtance; thus the Ribs are joined to the *Sternum*; thus the Bodies of the *Vertebræ* are connected to each other, as are likewiſe the *Oſſa Pubis*.

2. *Synneuroſis*, or *Syndeſmoſis*, when Ligaments are the connecting Bodies, as they are in all the moveable Articulations.

3. *Syſſarcoſis*, when Muſcles are ſtretched from one Bone to another, as they muſt be where there are moveable Joints, and frequently too where Bones are not moveable.

The ſecond Claſs of Articulations the *Synarthroſis*, which is ſaid to be the general Term by which the immoveable Conjunction of Bones is expreſſed, is divided into three Kinds.

1. The *Suture* [*] is that Articulation where two Bones are mutually indented into each other, or as if they were ſowed together, and is formed by the Fibres of two Bones meeting while they are yet flexible and yielding, and have not come to their full Extent of Growth, ſo that they mutually force into the Interſtices of each other, till meeting with ſuch Reſiſtance as they are not able to overcome, they are ſtopped from ſprouting out farther or are reflected; and therefore, theſe Indentations are very different both in Figure and Magnitude. Thus the Bones of the Head are joined; thus *Epiphyſes* are joined to the Bones, before their full Connexion and Union with them.

Under this Title of *Suture*, the *Harmonia* of the Antients may be comprehended, ſince, as

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[†] Amphiarthroſis.

[*] Ῥάφη.

*Veſalius* (*a*) has well remarked, ſcarce any unmoved Bones are joined by plain Surfaces.

2. *Gomphoſis* * is the fixing one Bone into another, in the ſame Manner as a Nail is fixed in a Board; thus the Teeth are ſecured in their Sockets.

3. *Schindyleſis* or *Ploughing* (*b*), when a thin *Lamella* of one Bone is received into a long narrow Furrow of another; thus the *Proceſſus azygos* of the *ſpenoid* Bone and the naſal Proceſs of the *ethmoid* Bone, are received by the *Vomer*.

The *third* Claſs or *Diarthroſis* † is that Articulation where the Bones are ſo looſely connected as to allow a large Motion. This is ſubdivided into three Kinds,

The firſt is *Enarthroſis*, or the Ball and Socket, when a large Head is received into a deep Cavity, as the Head of the *Os Femoris* is into the *Acetabulum Coxendicis*.

The ſecond is *Arthrodia*, when a round Head is received into a ſuperficial Cavity, as in the Articulation of the Arm-bone and *Scapula*: both this and the former Sort of Articulation allow Motion to all Sides.

The third is *Ginglimus* ‡, which properly ſignifies the Hinge of a Door or Window; in it, the Parts of the Bones mutually receive and are received, and allow of Motion two Ways; Workmen call it *Charnal*.

The *Ginglimus* is generally divided into theſe three

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(*a*) Obſerv. Fallop. examen.

* Conclavatio.

(*b*) *Keil* Anat. chap. 5. Sect. 3.

† Ἀπαρθρώσις, Dearticulatio, Abarticulatio.

‡ Articulatio mutua.

hree Kinds, to which *Baker* (a) gives the Names of *proximus*, *longus* and *compoſitus*.

The firſt kind of *Ginglimus* is when a Bone has ſeveral Protuberances and Cavities, which anſwer to as many Cavities and Proceſſes of the other Bone with which it is articulated, as in the Conjunction of the *Femur* with the *Tibia*.

The *Second* Species is, when a Bone receives another at one End, and is received by the ſame Bone at the other Extremity, as in the *Radius* and *Ulna*.

The laſt Sort is, when a Bone receives another, and is received by a third, as in the oblique Proceſſes of the *Vertebræ*.

When I firſt mentioned the Articulations of Bones, I ſaid there were different Opinions concerning the Uſe of theſe technical Words applied to the Conjunctions of Bones, *e.g.* It has been ſaid, that *Symphyſis* ſhould be the Name for the immoveable Articulations, and that by *Synarthroſis* ſhould be underſtood the Conjunction of Bones by ſome connecting *Medium*.--- Thoſe who have taken *Symphyſis* in the Senſe I did, of its expreſſing the Conjunction of Bones with a connecting Subſtance, have diſagreed in their Definition of it, ſome inſerting and others leaving out its allowing Motion.—— Where they have agreed in their Definition, they have not been of the ſame Mind concerning the Species of it. For ſeveral think the *Syſarcoſis* and *Syndeſmoſis* applicable to ſo many Joints which are univerſally allowed to be claſſed under the *Diarthroſis*, that it muſt cre-

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(a) Curſ. Oſteolog. Demonſtr. 1.

ate Confuſion to name them by any Species of the *Symphyſis*.—— Few keep to ſuch a general Definition of the *Synchondroſis* as I have done, and whether they determine it to allow no Motion, or an obſcure or a manifeſt one, bring themſelves into Difficulties, becauſe there are Examples of all theſe three Kinds.—— Some again, by too nicely diſtinguiſhing obſcure and manifeſt Motions of Bones, have blended the *Synarthroſis* and *Diarthroſis*, and from thence have branched out the different compound Species of Articulations that may be formed of them ſo far, that they could find no Examples in the Body to illuſtrate them by.—— It would be tedious to enumerate more of the jarring Opinions, and it would be far more ſo to give a Detail of the Arguments uſed by the Diſputants. It is ſufficient for my Purpoſe that it is underſtood in what Senſe I take theſe technical Terms, which I do in the following Manner.

When I mention the *Symphyſis* or *Synarthroſis*, or any Species of them, I ſhall always underſtand them according to the Explication I have firſt given of them. But tho' the Account already given of the *Diarthroſis*, or Articulation of moveable Bones, has been almoſt univerſally received as juſt; yet ſeeing it does not comprehend all the moveable Articulations of the Body, and one of its Species does not anſwer to any Notion we can have of the Conjunction of two Bones, I muſt beg leave to change the Definitions and Kinds of theſe Joints.

I would call *Diarthroſis* that Conjunction of Bones, whereby they are fitted for Motion, eing each covered with a ſmooth Cartilage, onnected by one or more common Ligaments, nd lubricated with *Synovia* at the conjoined Parts. In which Definition, I have no Regard o the Quantity of Motion which they really do perform; the Motion being often confined or enlarged by ſome other Cauſe not immediately depending on the Frame of the two Surfaces of the Bones, forming the particular Joint, which then is conſidered.

The firſt Species of the *Diarthroſis*, viz. the *Enarthroſis* or Ball and Socket, I would define more generally than above, That Articulation where a round Head of one Bone is received into a Cavity of another, and conſequently without ſome foreign Impediment, is capable of Motion to all ſides: Examples of this kind are to be ſeen in the Articulation of the Thigh-bone and *Oſſa innominata*; of the Arm-bone, and *Scapula*; *Aſtragalus* and *Os Naviculare*; *Magnum* or *Capitatum* of the Wriſt, with the *Scaphoides* and *Lunare*; firſt Bone of the Thumb with the ſecond, &c.

The ſecond Sort or the *Arthrodia*, differing from the *Enarthroſis* in the preceeding Account only in the Cavity's being more ſuperficial, which makes no eſſential Difference, eſpecially ſeeing that in the recent Subject, Cartilages or Ligaments ſupply the Deficiency of Bone, ought, in my Opinion, to be called with *Veſalius* (a) that Articulation of two Bones adapted for Motion, where it is not at firſt Sight obvious, which of the two has the Head or Cavity or where they are joined by plain Surfaces, or nearly ſo; ſuch is the Conjunction of the *Clavicle* with the *Scapula*; *Oſſa Cuneiformia* with the *Os Naviculare*; *Metatarſal* Bones with the *Oſſa Cuneiformia*, &c. From the Nature of this ſort of Joint, it is plain that very great Motion cannot be allowed without the Bones going farther out of their natural Situation, than is convenient or ſafe.

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(a) De corp. human. fabrica, lib. 1. Cap. 4.

*Ginglimus* I would reckon that Articulation, by the Form of which, the Motion of the joined Bones muſt be chiefly confined to two Directions which Hinges of Doors are.

The firſt Species of this is the *Trochoides*, when the one Bone turns on the other, as a Wheel does on its Axis; thus the firſt *Vertebra* of the Neck moves on the Tooth-like Proceſs of the ſecond. This is moſt commonly neglected by late Writers, though it is the moſt proper kind of *Ginglimus*.

The ſecond Species ſhould be eſteemed that Articulation, where ſeveral prominent and hollow Surfaces of two Bones move on each other, within the ſame common Ligament, as in the Knee, Elbow, *&c.*

The third Sort of *Ginglimus*, is when two Bones are articulated to each other at different Parts, with a diſtinct *Apparatus* of the motory Machines at each, ſuch is the Articulation of the *Os Occipitis* with the firſt *Vertebra* of the Neck, of any two contiguous *Vertebræ* by their oblique Proceſſes, of the Ribs with the Bodies and tranſverſe Proceſſes of the *Vertebræ*, of the *Radius* with the *Ulna*, *Tibia* with the *Fibula*, *Aſtragalus* with the *Calcaneum*, &c.

I would entirely throw out what is commonly enumerated as the third Kind of *Ginglimus*, for in conſidering the Conjunction of a Bone with two others, as in the common Example of a *Vertebra* joined with the one above and below, each ought to be obſerved diſtinct; otherwiſe we might with the ſame Propriety eſteem the Articulations that the long Bones, ſuch as the *Femur*, *Tibia*, *Humerus*, &c. have at their different Extremities, as one Articulation, which is abſurd.

If the moveable Bones were not connected and kept firm by ſome other ſtrong Subſtance, they would be luxated at every Motion of the Joints; and if their hard rough unequal Surfaces were to play on each other, their Motion would not only be difficult, but the Loſs of Subſtance from Attrition would be great: Therefore *Ligaments* are made to obviate the firſt, and *Cartilages* to prevent the other Inconveniency; but, becauſe Ligaments and Cartilages would turn rigid, inflexible and rough, unleſs they were kept moiſt, a ſufficient Quantity of proper Liquors is ſupplied for their Lubrication, and to preſerve them in a flexible State. Seeing then theſe parts are ſo neceſſary to the Articulations, I ſhall next conſider their Structure, Situation and Uſes, as far as they are ſubſervient to the Bones, and their Motions.

LIGAMENTS † are white flexible Bodies, thicker and firmer than Membranes, and not ſo hard or firm as Cartilages, without any remarkable Cavity in their Subſtance, difficultly ſtretched and with little Elaſticity, ſerving to connect one Part to another, or to prevent the Parts to which they are fixed from being removed out of that Situation which is uſeful and ſafe.

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† Σύνδεσμοι, νεῦροι, Copulæ, Vincula.

After Maceration in Water, the Ligaments can eaſily be divided, and each ligamentous Layer appears compoſed of Fibres, the largeſt of which are diſpoſed in a longitudinal Direction.

The *Arteries* of Ligaments are very conſpicuous after a tolerable Injection, and the larger Trunks of their Veins are ſometimes to be ſeen full of Blood.

Such Ligaments as form the ſides of Cavities have numerous Orifices of their Arteries opening upon their internal Surface which keep it always moiſt; if we rub off that Moiſture and then preſs the Ligament we can ſee the Liquor ouzing out from ſmall Pores and we can force thin Liquors injected by the Arteries into the Cavities formed by Ligaments.

Theſe exhalant Arteries muſt have correſponding abſorbent *Veins*, otherwiſe the Cavities would ſoon be too full of Liquor.

Ligaments then muſt be ſubject to the Diſeaſes common to other Parts where there is a Circulation of Fluids.

Authors generally ſay, that Ligaments are inſenſible, and conſequently it may be inferred that they have no Nerves beſtowed on them; but the violent racking Pain, felt on the leaſt Motion of a Joint labouring under a *Rheumatiſm*, the Seat of which Diſeaſe ſeems often to be in the Ligaments, and the inſufferable Torture occaſioned by a Collection of acrid Matter in a Joint, or by *Tophi* in the Gout, would perſwade us that they are abundantly ſupplied with Nerves.

The Ligaments which ſerve to connect the moveable Bones, commonly riſe from the Conjunction of the *Epiphyſes* of the one Bone, and are inſerted into the ſame Place of the other;

or where *Epithyſes* are not, they come out from the *Cervix*, and beyond the *Supercilia* of the articulated Bones; and after ſuch a Manner in both Caſes, as to include the Articulation in a Purſe or Bag, with this Difference, depending on their different Motions, that where the Motion is only to be in two Directions, the Ligaments are ſtrongeſt on thoſe Sides towards which the Bones are not moved; and when a great Variety of Motions is deſigned to be allowed, the Ligaments are weaker than in the former Sort of Articulations, and are nearly of the ſame Strength all round.

Beſides theſe common circular Ligaments of the Joints, there are in ſeveral Places particular ones, either for the firmer Conjunction of the articulated Bones, or for reſtraining and confining the Motion to ſome one Side; ſuch are the *croſs* Ligaments of the Ham, the *round* one of the Thigh, *&c.*

From this Account of the Ligaments, *Fabricius ab Aquapendente*'s *(a)* Obſervation will appear juſt, that *cæteris paribus*, in whatever Articulation, the Ligaments are few, long and weak, the Motion will be more free and quick, but Luxations will frequently happen; and on the contrary, where the Ligaments are numerous ſhort and ſtrong, the Motion will be more confined, but ſuch a Joint will be leſs expoſed to Luxations.

Ligaments are alſo of Service to the Bones in ſeveral other Reſpects; to wit, They ſupply the Place of Bones in ſeveral Caſes to Advantage; thus the Parts in the *Pelvis* are more ſafely ſupported below by Ligaments, than they could

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(*a*) De Articul. Part. utilit. pars tertia.

could have been by Bone.——The Ligaments, placed in the great Holes of the *Oſſa innominata*, and between the Bones of the Fore-arm and Leg, afford convenient Origin to Muſcles.——Immoveable Bones are more firmly connected by them; of which the Conjunction of the *Os ſacrum* and *Oſſa innominata* is an Example. They afford a Socket for moveable Bones to play in, as we ſee Part of the *Aſtragalus* does on the Ligaments ſtretched from the Heel-bone to the *Scaphoid* Bone.

CARTILAGES † are ſolid, ſmooth, white, elaſtick Subſtances, between the Hardneſs of a Bone and Ligament; and covered with a Membrane named *Perichondrium*, which is of the ſame Structure and Uſe, as the *Perioſteum* of the Bones.

The Cartilages are compoſed of Plates, which are formed of Fibres diſpoſed much in the ſame Way as thoſe of the Bones are, as might be reaſonably concluded from obſerving Bones in a cartilaginous State before they oſſify; and from ſeeing, on the other Hand, ſo many Cartilages become bony: This may be ſtill farther confirmed, by the *Exfoliation* which Cartilages are ſubject to, as well as Bones; and a Demonſtration can be given of this Structure, after boiling, burning, and expoſing Cartilages to the Weather.

The Blood-Veſſels and Nerves are diſtributed to the Cartilages, in much the ſame Manner as to the Bones.

While Cartilages are in a natural State, it is to be remarked; *Firſt*, That they have no Cavity in their Middle for Marrow. *Secondly*,

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† Χονδροὶ.

That their exterior Surface is ſofteſt, which renders them more flexible; from this it is, that injected Liquors eaſily fill the Veſſels on their Surface, but ſeldom reach to their middle ſolid Part. And *Laſtly*, That, as the ſpecifick Gravity of Cartilages is near a third leſs than that of Bones, ſo the Coheſion of their ſeveral Plates is not ſo ſtrong as in Bones; whence Cartilages laid bare in Wounds or Ulcers, are not only more liable to corrupt, but exfoliate much ſooner than Bones do.

Cartilages ſeem to be principally kept from oſſifying, either by being ſubjected to alternate Motions of Flexion and Extenſion, the Effects of which are very different from any Kind of ſimple Preſſure, or by being conſtantly moiſtned; thus the Cartilages on the articulated Extremities of the great Bones of the Limbs, and the moveable ones placed between the moving Bones in ſome Articulations, which are obliged to ſuffer many and different Flexions, and are plentifully moiſtned, ſcarce ever change into Bone, while thoſe of the Ribs and Larynx are often found oſſified.——The middle angular Part of the Cartilages of the Ribs which is conſtantly in an alternate State of Flexion and Extenſion, by being moved in Reſpiration, is always the laſt of becoming bony.——In the *Larynx*, the *Epiglottis*, which is oftner bended and more moiſtned than the other four Cartilages, ſeldom is oſſified, while the others as ſeldom eſcape it in Adults.

The Cartilages begin to oſſify on their external Surface, unleſs when Moiſture or Flexion impede it, and the Oſſification proceeds internally till the *Cancelli* are at laſt formed, when a ſort of Marrow is depoſited into them: While this Change is a bringing about in the Subſtance of the Cartilages, their Blood-veſſels gradually appear bigger towards their internal Subſtance, and leſs on the external. This Change of a Cartilage from a natural State to its becoming Bone is at firſt View ſurpriſing, and, ſo far as I know, none has attempted to explain it; which I mention only, to have ſome Plea for an Apology, if I ſhould be thought to have failed in accounting for this *Phænomenon.*

The Cartilages, being naturally of ſuch firm Subſtance, and of a Compoſition a-kin to the Bones, will gradually acquire greater Solidity by conſtant Preſſure; and this Change will be made ſooneſt and moſt remarkably, where the Preſſure is greateſt, that is, at their external Surface.——The exterior Plates, when oſſified, are more compact and denſe than formerly, and therefore they will have a ſtronger Power of attracting thoſe in contact with them; while the Branches of Veſſels diſtributed to the firſt oſſified Plate, and thoſe that run in the Interſtices of the Fibres of this and of the Plate next to it, being now more compreſſed than formerly, will have a leſs Quantity of Fluids paſſing through them, and conſequently the other Branches will receive a proportionally larger Quantity; the *Momentum* of which, joined to that Power of Attraction or Force of Coheſion, increaſed by the greater Solidity of the Plates, will increaſe the Preſſure upon the more internal Plates, and haſten their hardning; after which theſe laſt Plates will produce the ſame Effects on the other contiguous to them: And thus the Oſſification muſt go on till all are become bony.——The Body thus changed, will have its former Dimenſions, or nearly ſo, becauſe its external Part oſſified firſt, and being rigid, yields little or nothing to the Powers that draw it towards the Axis of the Bone. But ſeeing the new Particles added from the circulating Fluids, during the Oſſification, do not compenſate for the Condenſation which all the Particles undergo, and thereby the Plates occupy leſs Space than they did while in a cartilaginous State, a Cavity is left in the Middle. And as all the Plates cohered and had croſs Fibres joining them, many of theſe Fibres are ſtretched irregularly from one Side of the Cavity to the other, and therefore form the *Cancelli*——The Branches of the Veſſels formerly diſtributed to the Plates being now much leſſened, the remaining Branches, which run tranſverſely, are conſequently proportionally increaſed, become very conſpicuous, and are diſperſed every where in the Cavity, to ſerve for the Secretion of Marrow.—— Thus, this flexible elaſtick ſolid Subſtance becomes a rigid inflexible cavernous Bone with Marrow contained in its *Cancelli*.

The Cartilages ſubſervient to Bones are, as *Celſus* (*a*) obſerves, ſometimes found on the Extremities of Bones which are joined to no other; but are never wanting on the Ends and in the Cavities of ſuch Bones as are deſigned for Motion: And in more than one inſtance, Cartilages are interpoſed between ſuch other Cartilages as cover the Heads and Cavities of articulated

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(*a*) De Re Medic. lib. 8. cap. 1.

lated Bones; nay they are alſo placed betwee immoveable Bones.

The Uſes of Cartilages, ſo far as they regard the Bones, are, to allow, by their Smoothneſs, ſuch Bones as are deſign'd for Motion to ſlide eaſily without Detrition, while by their Flexibility they accomodate themſelves to the ſeveral Figures neceſſary in different Motions, and by their Elaſticity they recover their natural Poſition and Shape, as ſoon as the Preſſure is removed.——This ſpringy Force may alſo aſſiſt the Motion of the Joint to be more expeditious.—— To theſe Cartilages we chiefly owe the Security of the moveable Articulations: For without them the bony Fibres would ſprout out, and intimately coaleſce with the adjoining Bone; whence a true *Anchyloſis* muſt neceſſarily follow; which never fails to happen when the Cartilages are eroded, as was already obſerved.——The moveable Cartilages interpoſed in Joints ſerve to make the Motions both freer and more ſafe than they would otherwiſe be.——Thoſe placed on the Extremity of Bones that are not articulated, as, on the Spine of the *Ilium*, Baſe of the *Scapula*, *&c.* ſerve to prevent the bony Fibres from growing out too far.——Cartilages ſometimes ſerve as Ligaments either to faſten together Bones that are immoveably joined, ſuch are the Cartilages between the *Os ſacrum* and *Oſſa Ilium*, the *Oſſa Pubis*, *&c.* or to connect Bones that enjoy manifeſt Motion, as thoſe beween the Bodies of the true *Vertebræ*. *&c.*——Cartilages very often do the Office of Bones to greater Advantage than theſe laſt could; as in the Cartilages of the Ribs, the

Cartilages which ſupply Brims of Cavities, *&c.*

The Liquor, which principally ſerves to moiſten the Ligaments and Cartilages of the Articulations, is ſupplied by Glands, which are commonly ſituated in the Joint, after ſuch a Manner as to be gently preſſed, but not deſtroyed by its Motion. By this means, when there is the greateſt Neceſſity for this Liquor, that is, when the moſt frequent Motions are performed, the greateſt Quantity of it muſt be ſeparated. Theſe Glands are ſoft and pappy, but not friable: They are moſtly of the conglomerate Kind, or a great Number of ſmall Glandules are wrapt up in one common Membrane. Their excretory Ducts are long, and hang looſe, like ſo many Fringes, within the Articulation; which by its Motion and Preſſure prevents Obſtructions in the Body of the Gland, or its Excretories, and promotes the Return of this Liquor, when fit to be taken up by the abſorbent Veſſels, which muſt be in the Joints as well as in the other Cavities of the Body; and at the ſame time the Preſſure on the excretory Ducts hinders a ſuperfluous unneceſſary Secretion, while the fimbriated Diſpoſition of theſe Excretories does not allow any of the ſecreted Liquor to be puſhed back again by theſe Canals towards the Glands, as *Cowper* (*a*) has juſtly remarked.

Beſides theſe conglomerate Glands, we meet ſometimes with ſmall ſimple *Folliculi*, obſerved by *Morgagni* (*b*), that are full of Liquor.

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(*a*) Anatomy Explicat. tab. 79. litt. E. E.
(*b*) Adverſat. 2. animad. 23.

Upon preſſing any of theſe Glands with the Finger, one can ſqueeze out of their Excretories a mucilaginous Liquor, which ſomewhat reſembles the White of an Egg or *Serum* of the Blood, but it is manifeſtly ſalt to the Taſte. It does not coagulate by Heat, as the *Serum* does; but turns firſt thinner, and when evaporated, leaves only a thin ſalt Film. Different Salts have much the ſame Effect on it as on the other Juices of our Body; for *Acids* coagulate it, and *Alkalies* attenuate it. The Quantity of this *Mucilage* conſtantly ſupplied, muſt be very conſiderable, ſince we ſee what a plentiful troubleſome Diſcharge of *Synovia* follows a Wound or Ulcer of any Joint, of which Liquor the Mucilage is a conſiderable Part.

The Veſſels which ſupply Liquors for making the Secretion of this Mucilage, and the Veins which bring back the Blood remaining after the Secretion, are to be ſeen without any Preparation, but after a tolerable Injection of the Arteries, the Glands are covered with them.

In a ſound State we are not conſcious of any Senſibility in thoſe Glands; but in ſome Caſes which I have ſeen, when they inflame and ſuppurate, the moſt racking Pain is felt in them: A melancholly, though a ſure Proof that they have Nerves.

Theſe mucaginous Glands are commonly lodged in a cellular Subſtance; which is alſo to be obſerved in other Parts of the Bag formed by the Ligaments of the Articulation, and contains a fatty Matter, that muſt neceſſarily be attenuated, and forced through the including Membranes into the Cavity of the Joint, by the Preſſure which it ſuffers from the moving Bones.

If then the Oil is conveyed from this cellular Subſtance, and if the attenuated Marrow paſſes from the *Cancelli* of the Bones by the large Pores near their Extremities, or in their Cavities, and ſweats through the Cartilages there into the Articulations; which it may, when aſſiſted by the conſtant Heat and Action of the Body, more eaſily do, than when it eſcapes thro' the compact Subſtance of the Bones in a Skeleton: If, I ſay, this Oil is ſent to a Joint, and is incorporated with the Mucilage, and with the fine Lymph that is conſtantly ouzing out at the Extremities of the ſmall Arteries diſtributed to the Ligaments, one of the fitteſt *Liniments* imaginable muſt be produced; for the *Mucus* diluted by the Lymph contributes greatly to its Lubricity, and the Oil preſerves it from hardning. How well ſuch a Mixture ſerves the Purpoſe it is deſigned for, *Boyle* (a) tells us he experienced in working his Air-pump; for the Sucker could be moved with much leſs Force after being moiſtned with Water and Oil, than when he uſed either one or other of theſe Liquors: And I believe every one at firſt View will allow the diluted Mucilage to be much preferable to ſimple Water. The *Synovia*, as this Liquor compoſed of Oil and Mucilage is commonly called, will therefore, while in a ſound State, effectually preſerve all the Parts concerned in the Articulations ſoft and flexible, and will make them ſlide eaſily on each other, by which their mutual Detrition on and Overheating may be prevented; in the Manner daily practiſed in Coach and Cart-wheels, by beſmearing them with Greaſe and Tar.

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(a) Phyſico-mechanic. Experim.

After the Liquor of the Articulations becomes too thin and unſerviceable, by being conſtantly pounded and rubbed between the moving Bones, it is reaſſumed into the Maſs of Blood by the abſorbent Veſſels.

When the *Synovia* is not rubbed betwixt the Bones, it inſpiſſates; and ſometimes when the Head of a Bone has been long out of its Cavity, this Liquor fills up the Place of the Bone, and hinders its Reduction; or if a Joint continues long unmoved, the *Synovia* cements the Bones, and occaſions a true *Anchyloſis*. *Ambroſe Parè (a)* ſays, he has frequently ſeen ſuch Caſes, and *Hildanus* (*b*) gives a particular Example of it.—— If the *Synovia* becomes too acrid, it erodes the Cartilages and Bones, as frequently happens to thoſe who labour under the *Lues Venerea*, *Scurvy*, *Scrophulæ* or *Spina ventoſa*.—— If this Liquor is ſeparated in too ſmall a Quantity, the Joint, as *Galen* (*c*) remarks, becomes ſtiff; and when with Difficulty it is moved, a crackling Noiſe is heard, as People advanced in Years frequently experience.—— This Sort of Diſeaſe *Aquapendente (d)* very accurately deſcribes, and rationally accounts for.—— If the Mucilage and Lymph are depoſited in too great a Quantity, and the abſorbent Veſſels do not perform their Office ſuf-

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(*a*) Chirurgie, livre 15. chap. 18.

(*b*) Obſervat. cent. 3. obſ. 77.

(*c*) De uſu Part. lib. 12. cap. 2.

(*d*) De articul. part. utilitat. pars 3.

ſufficiently, they may occaſion a Dropſy of the Joints, which *Hildanus* (*a*) has at large treated of.—— From this ſame Cauſe alſo the Ligaments are often ſo much relaxed as to make the Conjunction of the Bones very weak: Thence ariſe the Luxations from an internal Cauſe, which are eaſily reduced, but difficultly cured.—— Frequently when ſuch a ſuperfluous Quantity of this Liquor is pent up, it becomes very acrid, and occaſions a great Train of bad Symptoms; ſuch as, Swelling and Pain of the Joints, long ſinuous Ulcers and *Fiſtulæ*, rotten Bones, Immobility of the Joints, *Marcor* and *Atrophia* of the whole Body, hectic Fevers, &c. *Hippocrates* (*b*) deſcribes accurately moſt of theſe Symptoms from the diſeaſed *Mucus* of the Joints, and *Hildanus* (*c*) gives the Hiſtories of many People labouring under them.

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(*a*) De Ichore & Meliceria acri Celſi.
(*b*) De locis in homine & de articul.
(*c*) De Ichore & Meliceria acri Celſi.

# THE ANATOMY OF THE Human Bones.

## PART II.

### Of the Skeleton.

ALL the Bones of an Animal, freed from the Teguments, Muſcles, Veſſels, Glands and *Viſcera*, and orderly connected, have the general Deſignation of a *Skeleton* *. This Term might be applied to any dry Preparation, but is now, by the common Conſent of Anatomiſts, reſtricted to this Preparation of the Bones.

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* Cadaveris crates.

Of theſe *Skeletons* there are two Sorts; one natural, when the Bones are kept together by their own Ligaments; the other artificial, when they are joined with Wire, or any other Subſtance which is not Part of the Creature to which the Bones belonged. Small Subjects, and ſuch whoſe Bones are not fully oſſified, are commonly prepared the firſt Way; becauſe were all their Parts divided, the niceſt Artiſt could not rejoin them, by reaſon of their Smallneſs, and of the Separation of the unoſſified Parts; whereas the Bones of large adult Animals are ſooneſt and moſt conveniently cleaned when ſingle, and there is no great Difficulty in reſtoring them to, and keeping them firm in their former natural Situation.

Sometimes we prepare the Skeletons of the ſame Animal in both theſe Ways, that is, we leave the ſmaller Bones joined by their natural Ligaments, and ſeparate the larger ones till they are cleaned, when they are again connected by Wires or ſome ſuch Subſtances.

Before we proceed to the Diviſion and particular Deſcription of the Skeleton, 'tis worth while to remark with *Cowper* (*a*), that when the Bones are put into the natural Situation, ſcarce any one of them is ſo placed as to be in a perpendicular Bearing to another; tho' the Fabrick compoſed of them is ſo contrived, that in an erect Poſture, a perpendicular Line from their common Center of Gravity falls in the Middle of their common Baſe. By this Contrivance we can ſupport ourſelves as firmly, as if the Axis of all the Bones had been a ſtraight

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(*a*) Anat. of human Bodies, Explic. of Tab. 87, 88.

ſtraight Line perpendicular to the Horizon; and we have at the ſame Time a much greater Facility and Strength in ſeveral of the moſt neceſſary Motions we perform. It is true indeed, that wherever the Bones, on which any Part of our Body is ſuſtained, decline from a ſtreight Line, the Force required in the Muſcles to counteract the Gravity of that Part, is greater than otherwiſe it needed to have been; but then this is effectually provided for in ſuch Places, by the Number and Strength of the Muſcles. As long therefore as we remain in the ſame Poſture, a conſiderable Number of Muſcles muſt be in a conſtant State of Contraction; which we know, both from Reaſon and Experience, muſt ſoon create an uneaſy Senſation. This we call being weary of one Poſture: An Inconvenience that we ſhould not have had in ſtanding erect, if the Bearing of all the Bones to each other had been perpendicular; but is ſufficiently compenſated by the Quickneſs, Eaſe and Strength of a great Variety of other Motions, as was above hinted.

The human Skeleton is generally divided into the *Head*, *Trunk*, *ſuperior* and *inferior Extremities*.

## *Of the Head.*

BY the *HEAD* is meant all that ſpheroidal Part which is placed above the firſt *Vertebra* of the Neck. It therefore comprehends the *Cranium* and Bones of the *Face*.

The *Cranium* *, Helmet or Brain-caſe, as the Word imports, conſiſts of ſeveral Pieces; which joined, form a vaulted Cavity for lodging and defending the Brain, *Cerebellum*, Membranes and Veſſels.

The Cavity of the *Cranium* is proportioned to its Contents. Hence ſuch a Variety of its Size is obſerved in different Subjects; and hence the Fore-part of the Scull, in which the anterior Lobes of the Brain are lodged, is neither ſo broad nor ſo deep as it is behind, where the large poſterior Lobes of the Brain, and the whole *Cerebellum* are contained.

The roundiſh Figure of the Scull, which makes it more capacious and better able to defend its Contents from external Injuries, is chiefly owing to the equal Preſſure of theſe contained Parts, as they grow and increaſe before it is entirely oſſified.— It is to be obſerved however, that in Adults the Sides of the *Cranium* are depreſſed below a ſpherical Surface by the ſtrong temporal Muſcles, whoſe Action hinders here the uniform Protruſion of the Bones, which is more equally performed in other Parts, where no ſuch large Muſcles are to be found. In Children, whoſe Muſcles have not acted much, and conſequently have not had great Effects on the Bones, this Depreſſion is not ſo remarkable; and therefore their Heads are rounder than in Adults. Theſe natural Cauſes differently diſpoſed in different People, produce a great Variety in the

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* Κόγχος, *κύτος*, *κώδεια*, *σκαφίον*, calva, calvaria, cerebri galea, theca & olla capitis, teſta capitis, ſcutella capitis.

Shapes of Sculls, which is ſtill increaſed by the different Management of the Heads of Children when very young: So that one may, with *Veſalius* (a), know a *Turk*'s Scull by its globular Figure, a *German*'s by its Breadth and Flatneſs of the *Occiput*, *Dutch* and *Engliſh* by their oblong Shapes, *&c.* Two Advantages are procured from this Flatneſs of the Sides of the *Cranium*, *viz.* the Enlargement of our Sphere of Viſion, and more advantageous Situation of our Ears, for receiving a greater Quantity of Sound, and for being leſs expoſed to Injuries.

The external Surface of the upper Part of the *Cranium* is very ſmooth and equal, being only covered with the *Perioſteum*, (common to all the Bones, but in the Scull diſtinguiſhed by the Name of *Pericranium*,) the thin *frontal* and *occipital* Muſcles, their tendinous *Aponeuroſis*, and with the common Teguments of the Body; while the external Surface of its lower Part, is all over full of Riſings, Depreſſions and Holes, which afford a convenient Origin and Inſertion to the Muſcles that are connected to it, and allow a ſafe Paſſage for the Veſſels that run through and near it.

The internal Surface of the upper Part of the Scull is commonly ſmooth, except where the Veſſels of the *dura Mater* have made Furrows in it, while the Bones were ſoft.—— Surgeons ſhould be cautious when they trepan here, leſt in ſawing or raiſing the Bone where ſuch Furrows are, they wound the Veſſels of the *dura Mater*.—— In the upper Part of the internal

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(a) Lib. 1. cap. 5.

Surface of ſeveral Sculls there are likewiſe Pits of different Magnitudes and Figures, which ſeem to be formed by ſome Parts of the Brain more luxuriant and prominent than others. Where theſe Pits are, the Scull is ſo much thinner than any where elſe, that it is often rendered diaphanous, the two Tables being cloſely compacted without a *Diploe*; the Want of which is ſupplied by Veſſels going from the *dura Mater* into a great many ſmall Holes obſervable in the Pits. Theſe Veſſels are larger and much more conſpicuous than any others that are ſent from the *dura Mater* to the Scull, as evidently appears from the large Drops of Blood they pour out when the Scull is raiſed from the *dura Mater* in a recent Subject; and therefore they may afford a ſufficient Quantity of neceſſary Liquors, to prevent the Brittleneſs of this thin Part.—— The Knowledge of theſe Pits ſhould be a Caveat for Surgeons, who, in the Operation of the Trepan, hurry on till they have pierced the firſt Table; ſince in a Patient, whoſe *Cranium* is thus pitted, the *dura Mater* and Brain may be injured, before the Inſtrument has pierced near the ordinary Thickneſs of the Scull.—— The internal Baſe of the Scull is extremely unequal, for lodging the ſeveral Parts and *Appendices* of the Brain and *Cerebellum*, and allowing a Paſſage and Defence to the Veſſels and Nerves that go into or come out from theſe Parts.

The Bones of the *Cranium* are compoſed of two Tables, and an intermediate bony cellular Subſtance, commonly called their *Diploe* †.

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† Meditullium, commiſſura.

The external Table is thickeſt; the inner, from its Thinneſs and conſequent Brittleneſs, has got the Name of *Vitrea.* Whence we may ſee the Reaſon of thoſe miſchievous Conſequences, which ſo often attend a Collection of Matter in the *Diploe*, either from an external or internal Cauſe, before any Sign of ſuch a Collection appears in the Teguments that cover the Part of the Scull where it is lodged.

The *Diploe*, has much the ſame Texture as the *Cancelli* of other Bones, and contains Marrow, which having numerous Branches of Veſſels ſpread on its Membranes, ſeems bloody. Theſe *Cancelli*, with their Marrow, ſerve the ſame Uſes here as they do in other Bones.—— I have found the *Diploe* in ſeveral old Subjects ſo obliterated, that ſcarce any Veſtige of it was to be ſeen; neither is it obſervable in ſome of the hard craggy Bones at the Baſe of the Scull.———Hence another uſeful Caution to Surgeons who truſt to the Bleeding, Want of Reſiſtance, and Change of Sound, as certain Marks in the Operation of the Trepan, for knowing when their Inſtrument has ſawed through the firſt Table, and reached the *Diploe*.

The *Cranium* conſiſts of eight Bones, ſix of which are ſaid to be proper, and the other two are reckoned common to it and to the Face. ——— The ſix proper are the *Os frontis*, two *Oſſa parietalia*, two *Oſſa temporum*, and the *Os occipitis*.——— The common are the *Os Ethmoides* and *Sphenoides*.

The *Os frontis* forms the whole Fore-part of the Vault, the two *Oſſa parietalia* form the upper Part of the Sides, the *Oſſa temporum* compoſe the lower Part of the Sides, the *Os occipitis* the whole hinder Part and ſome of the Baſe, the *Os Ethmoides* is placed in the Forepart of the Baſe, and the *Os Sphenoides* is in the Middle of it.

Theſe Bones are joined to each other by five *Sutures*; the Names of which are the *Coronal*, *Lambdoid*, *Sagittal*, and two *Squamous*.

The *Coronal* † Suture is extended over the Head, from within an Inch or ſo of the external *Canthus* of one Eye, to the like Diſtance from the other, which being near the Place where the Ancients wore their *Vittæ*, *Coronæ*, or Garlands, this Suture has hence got its Name.--- 'Tis to be remarked, That for an Inch or more, at the lower Part of this Suture on each Side, the Indentations which are ſo evident thro' the reſt of it are not obſervable; but this Juncture becomes plainly ſquamous and very ſmooth, by the parietal mounting on the frontal Bone, and by their being accurately applied to each other. This probably proceeds from the Action of the temporal Muſcles, Bones being generally ſmooth where Bellies of Muſcles cover them. The Muſcles, by this Mechaniſm, are leſs expoſed to any Harm from ſharp Points or unequal Surfaces of the Bones.

The *Lambdoidal* * *Suture* begins ſome way below, and farther back than the *Vertex* or Crown of the Head, whence its two Legs are ſtretched obliquely downwards, and to each Side, in form of the *Greek* Letter Λ, and are now generally ſaid to extend themſelves to the

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† Στεφαναῖα, Arcualis. Puppis.

* Laudæ, Proræ, Hypſyloides.

*Baſe* of the Scull; but the old Anatomiſts reckoned the proper *Lambdoid* Suture to terminate at the *Squamous* Sutures, and what is extended at an Angle down from that on each Side they called *Additamentum ſuturæ Lambdoidis* †.

This *Suture* is ſometimes very irregular, ſeeming to be made up of a great many ſmall Sutures, which ſurround ſo many little Bones, that are generally larger and more conſpicuous on the external Surface of the Scull, than internally. Theſe had the Name of *Triquetra* beſtowed on them by their firſt Diſcoverers, who, it ſeems, found ſome of them approaching to a triangular Figure; but, for the moſt Part, they are far from ſuch a Shape. They are alſo called *Wormiana*, from *Olaus Wormius* the *Dane*, who, beſides the larger ones reckoned Specificks in the Epilepſy, demonſtrated (*a*) ſeveral ſmall Bones of this Kind, that were generally overlooked by his Cotemporaries, but ſeem to be both deſcribed and painted by many Authors who wrote before him.

The Formation of the *Oſſa Triquetra*, is owing to the Bones betwixt which they are found, becoming too ſolid before their bony Fibres meet, and therefore incapable of ſhooting ſo far as they ought; for then the middle Space which remains unoſſified, begins to aſſume a bony Nature at ſeveral diſtinct Points that gradually enlarge, and at laſt, each of theſe bony Pieces is indented into the larger Bones, and into each other. Probably thoſe Children who have a large opening in this Place at their Birth, will have the largeſt *Oſſa Triquetra*.—— To confirm this Account of the Formation of theſe little Bones, we may remark, that ſuch Bones are ſometimes ſeen in other Sutures as well as in the *Lambdoid*. *Veſalius* (a) paints one at the Meeting of the *ſquamous* and *ſphenoid* Sutures; *Paaw* (b) tells us he ſaw that Part of the *parietal* and *frontal* Bones, where the *Fontanelle* is in Children, ſurrounded with a Suture; *Ruyſch* (c) relates four Examples of ſuch Bones in the *Sutura ſquamoſa*, three in the *Coronal*, and two between the *Os frontis* and *Sphenoides*; ſome ſuch Examples are alſo related by *Bartholin* (d); and I have ſeen ſeparate diſtinct Bones at the Conjunction of the *Ethmoid* and *Sphenoid*, of the *ſphenoid* and *parietal* Bones, and in the *Coronal* Suture.

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† *Lambdoides harmonialis, Lambdoides inferior, Occipitis Cornua.*

(*a*) Muſæum, lib. 3, cap. 26.

The *Sagittal* Suture † is placed longitudinally in the middle of the ſuperior Part of the Scull, and commonly terminates at the middle of the *Coronal* and of the *Lambdoid* Sutures, between which it ſeems placed as an Arrow is between the String and Bow.—— However this Suture is frequently continued through the Middle of the *Os Frontis*, down to the Root of the Noſe; and according to *Riolan* (a) this oftner happens in Women than Men, but is ſaid by *Veſalius* (b)

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(a) Lib. 1. cap. 6. fig. 4.

(b) In Hippocrat. de Capit. vuln.

(c) Muſæum Anat.

(d) Hiſt. anat. Cent. 1. hiſt. 51.

† Ῥαβδοειδὴς, ὀβελιαία, ἐπιζευγνῦσα, Inſtar virgæ, nervalis, inſtar teli, inſtar veru, ſecundum capitis longitudinem prorepens, conjungens, columnalis, recta, acualis.

(a) Anat. Sect. 2. cap. 19.

(*b*) to be met with more freqently in Male Sculls than in Female: Each have their Partizans, and probably the Authors, who have not blindly followed the Authority of former Writers, have given their Opinion according to the Difference in the Sculls examined by them. Among the Sculls which I have ſeen thus divided, the Female are the moſt numerous.—— *Veſalius (c)*, *Paaw (d)*, and *Laurent (e)* have delineated and deſcribed the *Sagittal* Suture ſometimes dividing the *occipital* Bone as far down as the great Hole through which the *Medulla ſpinalis* paſſes; this I never ſaw, nor have I ſeen ſuch a double ſagittal Suture as *Euſtachius* mentions.

In ſome old Sculls that are in my Poſſeſſion, ſcarce is there a Veſtige of any of the three *Sutures* which I have now deſcribed. In other Heads, one or two of the Sutures only diſappear; but I never could diſcover any Reaſon for thinking them diſpoſed in ſuch different Manners in Sculls of different Shapes as *Hippocrates (a)* and *Galen* (*b*) alledge they are.

The *Squamous Agglutinations* or *Falſe Sutures* † are one on each Side, a little above the Ear, of a ſemicircular Figure, formed by the overlopping (like one Scale upon another) of the upper Part of the *temporal* Bones on the lower Part of

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(*b*) Lib. 1. cap. 6. & in Epitome.

(*c*) Lib. 1. cap. 5. fig. 3. 4. & in text. cap. 6.

(*d*) In Cels. de re medic. cap. 1.

(*e*) Hiſt. anat. lib. 2. cap. 16.

(*f*) Oſſium examen.

(*a*) De Vulner. Capitis.

(*b*) De oſſib. cap. 1. & de uſu Part. lib. 9. cap. 17.

† Λεπιδοειδῆ προσκολλήματα, κροταφίαι, Temporales, Corticales, Mendoſæ, Harmoniales, Commiſſuræ in unguem.

of the *parietal*, where in both Bones there are a great many ſmall Riſings and Furrows, which are indented into each other, tho' theſe Inequalities do not appear till the Bones are ſeparated. In ſome few Sculls indeed, *Columbus* (*c*) and *Dionis* (*d*) have juſtly remarked the Indentations here to be as conſpicuous externally as in other Sutures; and what is commonly called the poſterior Part of this ſquamous Suture, always has the evident ſerrated Form, and therefore is reckoned by ſome a diſtinct Suture under the Name of *Additamentum poſterius ſuturæ ſquamoſæ*.

We ought here to remark with *Veſalius* (*e*) and *Winſlow* (*f*), that the true ſquamous Sort of Suture is made uſe of, to join all the Edges of the Bones on which the temporal Muſcles are placed, and is not confined to the Conjunction of the temporal and parietal Bones: For the two Parts of the ſphenoidal Suture which are continued from the anterior Extremity of the common ſquamous Suture juſt now deſcribed, of which one runs perpendicularly downwards, and the other horrizontally forwards, and alſo the lower Part of the coronal Suture already taken Notice of, may all be juſtly ſaid to pertain to the ſquamous *Suture*.— The Manner how I imagine this Sort of Suture is formed at theſe Places is, That by the Action of the ſtrong temporal Muſcles on one Side, and by the Preſſure of the Brain on the other, the Bones are made ſo thin as to admit of no other Suture; The *ſquamous* Form is alſo.

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(*c*) De re Anat. lib. 1. cap. 4.
(*d*) Anatomie 3. Demonſtr. des Os.
(*e*) Anat. lib. 1. cap. 6.
(*f*) Memoires de l'Acad. des Sciences 1720.

alſo more convenient here, becauſe ſuch thin Edges of Bones, when accurately applied one to another, have ſcarce any rough Surface, to obſtruct or hurt the Muſcle in its Contraction; which is ſtill further provided for, by the Manner of laying theſe Edges on each other; for in viewing their outſide, we ſee the temporal Bones covering the ſphenoidal and parietal, and this laſt ſupporting the ſphenoidal, while both mount on the frontal; from which Diſpoſition it is evident, that while the temporal Muſcle is contracting, which is the only Time it preſſes ſtrongly in its Motion on the Bones, its Fibres ſlide eaſily over the external Edges. Another Advantage ſtill in this is, that all this bony Part is made ſtronger by the Bones thus ſupporting each other.

The Bones of the Scull are joined to one another, and to thoſe of the Face, by Means of five Sutures, to wit, the *Ethmoidal*, *Sphenoidal*, *Tranſverſe*, and two *Zygomatic*.

The *Ethmoidal* and *Sphenoidal* ſurround the Bones of theſe Names; and in ſome Places help to make up other Sutures, particularly the *Squamous* and *Tranſverſe*; and in other Parts, there is but one Suture common to theſe two Bones.

The *Tranſverſe* Suture runs quite croſs the Face, from the external *Canthus* of one Orbit to the ſame Place of the other, by ſinking from the *Canthus* down the outſide of the Orbit to its Bottom; then mounting upon the Inſide, it is continued by the Root of the Noſe down the internal Part of the other Orbit, and up again to the other *Canthus*. It may be here remarked that there are ſome Interruptions of this Suture in the Courſe I have deſcribed, as the Bones are not contiguous every where, but are ſeparated, to leave Holes and Apertures to be mentioned hereafter.

The *Zygomatick* Sutures are one on each Side, being ſhort and ſlanting from above obliquely downwards and backwards, to join the poſterior Proceſs of the Cheek-bone to the Proceſs of the *Os temporum*, which advances towards the Face; ſo that the two Proceſſes thus united, form a Sort of Bridge, or *Jugum*, under which the *temporal* Muſcle paſſes.

It muſt be obſerved, that the Indentations of the *Sutures* do not appear on the Inſide of the *Cranium*, by much ſo ſtrong as on the Outſide, but the Bones ſeem almoſt joined in a ſtreight Line; nay in ſome Sculls, the internal Surface is found entire, while the Sutures are manifeſt without. *Winſlow* (*a*) proves, that by this Mechaniſm, there is no Risk of the ſharp Points of the Bones growing inwards, ſince the external *Serræ* of each of the conjoined Bones, reſt upon the internal ſmooth-edg'd Table of the other, and any external Force upon theſe Parts will be better reſiſted as the Sutures cannot yield, unleſs the ſerrated Edges of the one Bone and the plain internal Plate of the other are both broken.

The Manner how theſe Sutures are formed, was explained in the general Hiſtory of the Bones.

The Advantages of the Sutures of the *Cranium* are theſe, 1. That this *Capſula* is more eaſily formed and extended into a ſpherical Figure, than if it had been one continued Bone. 2. That in the Birth, as the Bones are at ſome Diſtance

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(*a*) Memoires de l' Acad. des Sciences, 1720.

ſtance from each other, they might, by yielding, allow to the Head a Change of Shape, accommodated to the Paſſage it is engaged in. Whence in hard Labour of Child-bed, the Bones of the *Cranium*, inſtead of being only brought into Contact, are ſometimes made to mount one upon the other: A remarkable Inſtance of this Kind I had occaſion to ſee in an Infant, one of whoſe *Oſſa parietalia* overlopped the other, and both were riding on the *Os occipitis*, which occaſioned a Redneſs and Swelling in all the external Parts of the Head, accompanied with either a conſtant crying and toſſing, or drowſy doſing and Inſenſibility. Theſe Symptoms went off in a few Hours after I had reduced the Bones to their natural Place. 3. With a view to the Sutures allowing ſome Tranſpiration of Steams from the Brain, which was the old Doctrine; or ſome Communication of the Veſſels without and of thoſe within the Scull, larger here than in any other Part of the *Cranium*, according to ſome Moderns, Phyſicians continue to order *Cucuphæ*, *Fomentations*, *Cataplaſms*, *cephalick Plaiſters*, *Bliſters* to be applied, and *Iſſues* to be eroded or cut in the Head, at thoſe Places where the Sutures are longeſt in forming, and where the Connection of the Bones is afterwards looſeſt, for the Cure of a *Phrenitis*, *Mania*, *inveterate Head-ach*, *Epilepſy*, *Apoplexy*, and other Diſeaſes of the Head. This Doctrine of Tranſpiration or Communication of Veſſels at the Sutures has occaſioned ſtrong Diſputes. If ſome Obſervators have not been ſo far biaſſed in its Favour, as to impoſe their Opinion inſtead of Facts, there would appear to be ſome Ground for this Doctrine. *Columbus (a) Verduc (b)* and *Dionis (c)* relate Obſervations of Perſons whoſe Sutures were too cloſely united, and who had been ſubject to Head-aches, which at laſt were mortal. 4. That the *dura Mater* may be more firmly ſuſpended by its Proceſſes which inſinuate themſelves into this Conjunction of the Bones; for doing this more equally, and where the greateſt Neceſſity of Adheſion is, the Sutures are diſpoſed at pretty equal Diſtances, and the large *Reſervoires* of Blood the *Sinuſes* are immediately under or near them. 5. That Fractures might be prevented from reaching ſo far as they would in a continued bony Subſtance. 6. That the Connection at the Sutures being capable of yielding, the Bones might be allowed to ſeparate, which has given great Relief to Patients from the violent Symptoms which they had before this Separation happened *(d)*; and it ſeems reaſonable to believe, that the opening of the Sutures was of great Benefit to ſeveral others who were rather judged to have been hurt by it *(e)*: For we muſt think, that the Conſequences of ſuch a Force acting upon the Brain, as was capable to thruſt the Bones

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(*a*) De re Anat. lib. 1. cap. 5.

(*b*) Nouvelle Oſteologie chap. 14.

(*c*) Anatomie 3. demonſtr. des Os.

(*d*) Ephemerid. Germanic. Dec. 1. Ann. 4 & 5. Obſerv. 33.

(*e*) Ibid. Dec. 2. Ann. 9. Obſerv. 230. Ibid. Cent. 10. Obſ. 31. Vander Linden Medicin. Phyſiolog. Cap. 8. Art. 4. § 16. Hildan. Obſerv. Cent. 1. Obſ. 1. Pechlin. Obſerv. Lib. 2. Obſerv. 40.

aſunder, muſt have been fatal, unleſs it had been thus yielded to.

Having gone through the general Structure of the *Cranium*, I now proceed to examine each Bone, of which that Brain-caſe conſiſts, in the Order in which I firſt named them.

The *OS FRONTIS* [†] has its Name from its being the only Bone of that Part of the Face we call the *Forehead*, tho' it reaches a good deal further. It has ſome Reſemblance in Shape to the Shell of that *Concha bivalvis*, which is commonly called the Cockle; for the greateſt Part of it is convex externally, and concave internally, with a ſerrated circular Edge, while the ſmaller Part has Proceſſes and Depreſſions, which make it of an irregular Figure.

The external Surface of the *Os frontis* is perfectly ſmooth at its upper convex Part; but ſeveral Proceſſes and Cavities are obſervable below: For at each Angle of each Orbit, the Bone jutts out to form four Proceſſes, two internal, and as many external, which from this Situation, may well enough be named *angular*. Between the internal and external angular Proceſſes of each Side, an arched Ridge is extended, on which the Eye-brows are placed.—— Very little above the internal Extremity of theſe *ſuperciliary* Ridges, a Protuberance may be remarked in moſt Sculls, where the Bone is protruded to make Room for two large Cavities, of which hereafter.——Betwixt the internal angular Proceſſes, a ſmall Proceſs riſes, which forms ſome Share of the Noſe, and thence is named *Naſal.*—Some obſerve a protuberant Part on the Edge of the Bone behind each external angular Proceſs, which they call *temporal* Proceſſes; but theſe are inconſiderable. —From the under Part of the ſuperciliary Ridges, the frontal Bone runs a great Way backwards, which Parts may juſtly enough be called *Orbitar* Proceſſes. Theſe contrary to the reſt of this Bone are concave externally for receiving the Globes of the Eyes with their Muſcles, Fat, *&c.*

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[†] Μετώπου, Βρέγμα, Coronale, Inverecundum, Puppis, Cenſus *communis*, quibuſdam Sincipitis.

In each of the *orbitar* Proceſſes behind the Middle of the ſuperciliary Ridges, a conſiderable Sinuoſity is obſerved, where the *Glandula innominata Galeni* or *lachrymalis* is lodged: —Behind the internal angular Proceſſes, a ſmall Pit may be remarked, where the Cartilaginous Pully of the *Muſculus obliquus major* is fixed.—Betwixt theſe two orbitar Proceſſes, a large Diſcontinuation of the Bone is to be ſeen, into which the cribriform Part of the *Os Ethmoides* is incaſed. The frontal Bone frequently has little Caverns formed in it here where it is joined to the Ethmoid Bone.—Behind the external angular Proceſſes, the Surface of the frontal Bone is conſiderably depreſſed, where Part of the *temporal* Muſcle is placed.

The *Foramina*, or Holes, obſervable on the external Surface of the frontal Bone, are three in each Side.—One in each ſuperciliary Ridge, a little remov'd from its Middle towards the Noſe; thro' which a Twig of the *Ophthalmick* Branch of the fifth Pair of Nerves paſſes out of the Orbit, with a ſmall Artery from the

Carotid, to be diſtributed to the Teguments and Muſcles of the Forehead.——Theſe Veſſels in ſome Sculls make Furrows in the *Os Frontis*, eſpecially in the Bones of Children, as *Ruſych* (*a*) has alſo well obſerved of another conſiderable Veſſel of this Bone near its Middle; and therefore, we ought to beware of tranſverſe Inciſions on either Side of the *Os frontis*, which might open theſe Veſſels, while they are yet in Part within the Bone; for in ſuch a Caſe, 'tis difficult to ſtop an Hæmorrhagy, becauſe the Adheſion of a Part of the Artery to the Bone, hinders its Contraction, and conſequently Stypticks can have little Effect; the Sides of the Furrow keep off compreſſing Subſtances from the Artery, and we would wiſh to ſhun Cauteries or Eſcharoticks, becauſe they make the Bone carious.—— But to return to the *ſuperciliary Foramina*, we muſt remark, that often inſtead of an Hole a Notch only is to be ſeen: Nay, in ſome Sculls, ſcarce a Veſtige even of this is left; in others both Hole and Notch are obſervable, when the Nerve and Artery run ſeparately. Frequently a Hole is found on one Side, and a Nich on the other; at other Times we ſee two Holes; or there is a common Hole without, and two diſtinct Entries internally.— Near the Middle of the Inſide of each Orbit, hard by, or in the *Sutura tranſverſalis*, there is a ſmall Hole left for the Paſſage of the naſal Twig of the firſt Branch of the fifth Pair of Nerves. This Hole is ſometimes intirely formed in the *Os frontis*; in other Sculls, the Sides of it are compoſed of this laſt Bone and of the *Os planum*

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(*a*) Mus. Anat. Theca D. Repoſit. 4. No. 3.

*num*. 'Tis commonly known by the Name of *Orbitarium internum*, tho' *anterius* ſhould be added, becauſe of the next, which is commonly omitted.—This, which may be called *Orbitarium internum poſterius*, is ſuch another as the former, only ſmaller, and about an Inch deeper in the Orbit: Through it a ſmall Branch of the internal *Carotid* Artery ſent off before it pierces the *dura Mater*, paſſes to the Noſe.—Beſides theſe ſix, there are a great Number of ſmall Holes obſervable on the outer Surface of this Bone, particularly in the two Protuberances above the Eye-brows, under which the *Sinuſes* are. Moſt of theſe penetrate no further than the *Sinuſes* or than the *Diploe*, if the *Sinuſes* are wanting; tho' ſometimes I have ſeen this Bone ſo perforated by a vaſt Number of theſe ſmall Holes, that placed between the Eye and a clear Light, it appeared like a Sieve; in the Orbit of the Generality of *Skeletons*, we may obſerve one, two, or more Holes, which allow a Paſſage to a Hog's Briſtle through the Scull. The Place, Magnitude and Number of theſe is however uncertain: They generally ſerve for the Tranſmiſſion of ſmall Arteries or Nerves.

The internal Surface of the *Os frontis* is concave, except at the orbitar Proceſſes, which are convex to ſupport the anterior Lobes of the Brain. This Surface is not ſo ſmooth as the external; for the larger Branches of the Arteries of the *dura Mater* make ſome Furrows in its lateral and poſterior Parts.—The Sinuoſities from the luxuriant Riſings of the Brain, mentioned when deſcribing the general Structure of the *Cranium*, are often very obſervable on its upper Parts and its lower and fore Parts are marked with the Contorſions of the anterior Lobes of the Brain.——Through the Middle of this internal Surface, where always in Children, and frequently in old People the Bone is divided, either a Ridge ſtands out, to which the upper Edge of the *Falx* is faſtned, or a Furrow runs, in which the upper Side of the ſuperior longitudinal *Sinus* is lodged; on both theſe Accounts Chirurgical Authors juſtly diſcharge the Application of the Trepan here. The Reaſon of this Difference in Sculls is alledged by ſome Authors to be this, That in thin Sculls the Ridge ſtrengthens the Bones, and in thick ones there is no occaſion for it. To this Way of accounting for this Phænomenon, it may juſtly be objected, that generally very thick Sculls have a large Spine here, and frequently thin ones have only a Furrow. Perhaps this Variety may be owing to the different Times of a complete Oſſification of theſe Parts in different Subjects: For if the two Sides of this Bone meet before they arrive at their utmoſt Extent of Growth, they will unite very firmly, and all their Fibres endeavour to ſtretch themſelves out where the leaſt Reſiſtance is, that is, between the Hemiſpheres of the Brain. To ſupport this Reaſoning we may remark, that thoſe Adults, whoſe frontal Bone is divided by the ſagittal Suture, never have a Ridge in this Place.

Immediately at the Root of this Ridge or Furrow there is a ſmall Hole, which ſometimes pierces through the firſt Table, and in other Sculls opens into the ſuperior *Sinus* of the *Ethmoid* Bone within the Noſe. In it a little Proceſs of the *Falx* is lodged, and a ſmall Artery, and ſometimes a Vein runs, as *Morgagni* (*a*) has taken notice; and the ſuperior longitudinal *Sinus* begins here.——This Hole however is often not entirely proper to the *Os frontis*; for in ſeveral Sculls I obſerve, with *Ingraſſias* (*b*), the lower Part of it formed in the ſuperior Part of the Baſe of the *Criſta Galli*, which is a Proceſs of the *Os Ethmoides*.

The *Os frontis* is compoſed of two Tables and an intermediate *Diploe*, as the other Bones of the *Cranium* are, and in a middle Degree of Thickneſs between the *Os occipitis* and *parietalia*, is pretty equally denſe all through, except at the orbitar Proceſſes, where, by the Action of the Eye on one Side, and Preſſure of the Lobes of the Brain on the other, it is made extremely thin and diaphanous, and the *Meditullium* is entirely obliterated. Since in this Place there is ſo weak a Defence for the Brain, the Reaſon appears, why Fencers eſteem a Puſh in the Eye ſo mortal (*c*).

The *Diploe* is alſo exhauſted in that Part above the Eye-brows where the two Tables of the Bone ſeparate, by the external's being protruded outwards to form two large Cavities, called *Sinus frontales*.——Theſe are divided by a middle perpendicular bony Partition.——Their Capacities in the ſame Subject are ſeldom equal, in ſome the Right, in others the Left is largeſt:——And in different Bones their Size is as inconſtant; nay I have examined ſome, where

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(*a*) Adverſar. 6 animad. 31.

(*b*) Comment. in Galen. de Oſſib. cap. 1. comment. 8.

(*c*) Ruyſch Obſerv. Anat. Chir. Obſerv. 54. Diemerbroeck Anat. Lib. 3. cap. 11.

where they were entirely wanting, which oftner happens in ſuch as have a flat Fore-head, and whoſe ſagittal Suture is continued down to the Noſe, than in others, as *Fallopius* (*a*) has remarked; and in Children they are never ſeen.—— In ſome Sculls, beſides the large perpendicular *Septum*, there are ſeveral bony Pillars, or ſhort Partitions found in each *Sinus*; in others theſe are wanting.——For the moſt part the *Septum* is entire, at other times it is diſcontinued, and the two *Sinuſes* communicate. ——When the *Sinuſes* are ſeen in ſuch Sculls as have the frontal Bone divided by the ſagittal Suture, the Partition dividing theſe Cavities is evidently compoſed of two Plates, which eaſily ſeparate.—— Each *Sinus* commonly opens by a roundiſh ſmall Hole, at the inner and lower Part of the internal angular Proceſſes, into a *Sinus* formed in the Noſe at the upper and back Part of the *Os unguis*; near to which there are alſo ſome other ſmall *Sinuſes* of this ſame Bone, obſerved by *Cowper* (*b*), the greater Part of which open ſeparately nearer the *Septum narium*, and often they terminate in the ſame common Channel with the large ones.

In a natural and ſound State theſe Cavities are of conſiderable Advantage; for the Organ of Smelling being thus enlarged, the *Effluvia* of odorous Bodies will more difficultly eſcape it.——Theſe and the other Cavities which open into the Noſe, increaſe the Sound of our Voice, and render it more melodious, by ſerving as ſo many Vaults to reſound the Notes. Hence People

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(*a*) Expoſit. de Offibus, cap. 13.
(*b*) Drake's Anthropolog. Book 3. Chap. 10.

People labouring under a *Coryza*, or Stoppage of the Noſe from any other Cauſe, when they are by the Vulgar, though falſely, ſaid to ſpeak through their Noſe, have ſuch a diſagreeable harſh Voice.

From the Deſcription of theſe *Sinuſes*, 'tis evident how uſeleſs, nay how pernicious it muſt be, to apply a Trepan on this Part of the Scull; for the Trepan, inſtead of piercing into the Cavity of the *Cranium*, would reach no further than the *Sinuſes*; or if it was puſhed on through the inner Table, any extravaſated Blood that happened to be within the Scull would not be diſcharged outwardly but would fall into the *Sinuſes*, there to ſtagnate, corrupt and ſtimulate the ſenſible Membranes, from which alſo there would be ſuch a conſtant Flow of glairy Mucus as would retard if not hinder a Cure, and would make the Sore degenerate into an incurable *Fiſtula*. Beſides, as it would be almoſt impoſſible in this Caſe to prevent the Air, paſſing thro' the Noſe, from having conſtant Acceſs to the *dura Mater* or Brain, ſuch a Corruption would be brought on theſe Parts as would be attended with great Danger. Further, in Reſpiration the Air ruſhing violently into theſe Cavities of the *Os frontis*, and paſſing thro' the external Orifice whenever it was not well covered and defended, (as *Paaw* (*a*) and *Palfyne* (*b*) tell us it did in their Patients) would not only prevent the cloſing up of the external Orifice, but might otherwiſe bring on bad Conſequences. *Palfyn's*

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(*a*) De Oſſibus Parſ. 1. Cap. 7.

(*b*) Anatomie chirurg. Traité 4. Chap. 15. Nouvelle Oſteologie Partie 2. Chap. 3.

*ſyn*'s Apothecary of *Lovain* was ſo oppreſſed when ever the ſmall external Paſſage into one of theſe *Sinuſes* was left open, that he deſpaired of living unleſs it were cured.

The upper circular Part of the *Os frontis* is joined to the *Oſſa parietalia* from one Temple to the other, by the coronal Suture. From the Termination of the coronal Suture to the external angular Proceſſes, this Bone is connected to the *ſphenoid* by the *ſphenoidal* Suture. At the external *Canthi* of the Eyes, its angular Proceſſes are joined by the tranſverſe Suture to the *Oſſa malarum*, to which it adheres one third down the outſide of the Orbits; whence to the Bottom of theſe Cavities, and a little up on their internal Sides, theſe orbitar Proceſſes are connected to the *ſphenoidal* Bone by means of that ſame Suture.—— In ſome few Sculls however, a Diſcontinuation of theſe two Bones appears at the ſuperior Part of the long Slit, at the Bottom of the Orbit.—— On the Inſide of each Orbit, the orbitar Proceſs is indented between the *cribriform* Part of the *ethmoid* Bone, and the *Os planum* and *unguis*; the tranſverſe Suture afterwards joins the frontal Bone to the ſuperior naſal Proceſſes of the *Oſſa maxillaria ſuperiora*, and to the *Oſſa naſi*. And, *laſtly*, Its naſal Proceſs is connected to the naſal *Lamella* of the *ethmoid* Bone.

The *frontal* Bone ſerves to defend and ſupport the anterior Lobes of the Brain. It forms a conſiderable Part of the Cavities that contain the Globes of the Eyes, helps to make up the *Septum narium*, Organ of Smelling, &c. From the Deſcription of the ſeveral Parts, the other Uſes of this Bone are evident.

In a Child born at the full Time, the frontal Bone is divided through the Middle: The ſuperciliary Holes are not formed; often a ſmall round Piece of each orbitar Proceſs, behind the ſuperciliary Ridge, is not oſſified, and there is no *Sinus* to be ſeen within its Subſtance.

Each of the two *OSSA PARIETALIA* *, or Bones ſerving as Walls to the *Encephalon* is an irregular Square, its upper and Fore-ſides being longer than the poſterior and inferior. This laſt Side is a concave Arch, the middle Part giving Way to the upper round Part of the temporal Bone, while the two Extremities are ſtretched out: That behind, to join the poſterior thick Part of the temporal Bone and the *Os occipitis*, and that before to meet the *ſphenoid* Bone. This laſt is ſo large, as to have the Appearance of a Proceſs.

The external Surface of the *Oſſa parietalia* is convex, and upon it, between the anterior and poſterior Edges, ſomewhat below the middle Height of the Bone, there is an arched Ridge, of a whiter Colour generally than any other Part of the Bone; from which, in Bones that have ſtrong Prints of Muſcles, we ſee a great many converging Furrows run down like ſo many *Radii* from a Circumference towards a Center. From this Ridge of each Bone, the Origin of the temporal Muſcle ariſes; and, by the Preſſure of its Fibres, occaſions the Furrows juſt now mentioned.—— Below theſe we obſerve, near the ſemicircular Edges, a great many Riſings and Depreſſions, which joined to like Inequalities of the temporal Bone, form the ſquamous Suture.

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* Κορυφῆς, Paria, ſyncipitis, verticis, arcualia, nervalia, cogitationis, rationis, bregmatis, madefactionis.

Near the upper Sides of theſe Bones, towards the hind Part, is a ſmall Hole in each, through which a Vein paſſes from the Teguments of the Head to the longitudinal *Sinus*. Sometimes I have ſeen a Branch of the temporal Artery paſs through this Hole, to be diſtributed to the upper Part of the *Falx*, and to the *dura Mater* at its Sides, where it had frequent Anaſtomoſes, with the Branches of the Arteries derived from the external Carotids, which commonly have the Name of the Arteries of the *dura Mater*.——— In ſeveral Sculls one of the *Oſſa parietalia* has not this Hole, in others there are two in one Bone, and in ſome not one in either. Moſt frequently this Hole is through both Tables; at other Times the external Table is only perforated.———The Knowledge of the Courſe of theſe Veſſels may be of Uſe to Surgeons, when they make any Inciſion near this Part of the Head, leſt if the Veſſels are raſhly cut near the Hole, they ſhrink within the Subſtance of the Bone, and ſo elude both Ligature and Medicines; whence an obſtinate Hæmorrhagy muſt follow; ſome Inſtances of which I have ſeen.

On the inner concave Surface of the parietal Bones we ſee a great many deep Furrows, diſpoſed ſomewhat like the Branches of Trees: Theſe are formed by the Pulſation of the Arteries of the *dura Mater*, while the Bones are young and ſoft. In ſome Sculls I have obſerved theſe Furrows ſo deep, that the Bone has ſprouted out on each Side till the Sides met, and made a ſort of bony Bridge over the Artery:

ry: which, as was obſerved in the general Deſcription of the *Cranium*, ought to make Surgeons cautious in ſawing and raiſing theſe Bones, when they perform the Operation of the Trepan.—— In theſe Furrows we frequently ſee Paſſages into the *Diploe*; and ſometimes I have obſerved Canals going off, which allowed a ſmall Probe to paſs ſome Inches into the bony Subſtance; *Cowper* (*a*) tells us he has obſerved theſe Canals piercing the Bone towards the *Occiput*.——Towards the upper Edge of the *Oſſa parietalia* in the Inſide, there is a large Sinuoſity, frequently larger in the Bone of one Side than of the other, where the upper Part of the *Falx* is faſtned, and the ſuperior longitudinal *Sinus* is lodged.——Near the inferior poſterior Angle of theſe Bones internally is a Depreſſion in ſeveral Subjects, formed by Part of the lateral *Sinus*.—— The Pits made by the prominent Parts of the Brain are to be ſeen in no Part of the Scull more frequent, or more conſiderable than in theſe parietal Bones.

The *Oſſa parietalia* are amongſt the thinneſt Bones of the *Cranium*, but enjoy the general Structure of two Tables and *Diploe* the completeſt, and are the moſt equal and ſmooth.

Theſe Bones are joined at their anterior Edge to the *Os frontis* by the coronal Suture; at their long inferior Angles, which ſome reckon Proceſſes, to the *ſphenoid* Bone, by Part of the Suture of this Name; at their lower Edge, to the *Oſſa temporum*, by the ſquamous Suture and its poſterior *Additamentum*; behind, to the *Os occipitis* or *Oſſa triquetra*, by the lambdoid

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(*a*) Anatom. Explic. of XC. Tab. Fig. a.

doid Suture; and above, to one another, by the ſagittal Suture.

They have no particular Uſes beſides thoſe mentioned in the Deſcription of their ſeveral Parts, except what are included in the general Structure of the *Cranium.*

In a Child born at the full Time none of the Sides of this Bone are completed, and the Hole, ſometimes found near to the ſagittal Suture in Adults, never is to be ſeen in a new-born Child.

The large unoſſified ligamentous Part of the *Cranium* obſervable between the anterior ſuperior Angles of the parietal Bones, and the Middle of the divided *Os frontis* of new-born Children, called by the Vulgar, the *Open of the Head*, was imagined by the Ancients to ſerve for the Evacuation of the ſuperfluous Moiſture of the Brain; and therefore they named it *Bregma* † or the Fountain, ſometimes adding the Epithet *pulſatilis* or beating, on account of the Pulſation of the Brain felt through this flexible Ligamento-cartilaginous Subſtance. Hence very frequently the parietal Bones are called *Oſſa Bregmatis.*

The *Bregma* is the firſt Part of a Child that comes out of the *Os uteri* in a natural Birth. If it is ſtretched, and the Pulſation of the Brain is felt through it, the Child is certainly alive. But if the *Bregma* is ſhrivel'd and flaccid, without any obſervable Pulſation in it, there is Reaſon to judge the Child to be very weak or dead. Thoſe who practiſe Midwifery ſhould be very careful to examine the State of the *Bregma* accurately.

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† Palpitans vertex, foliolum, folium, triangularis lacuna.

All the *Bregma* is generally oſſified before ſeven Years of Age: Several Authors (*a*) ſay, they have obſerved it unoſſified in Adults; and Phyſicians, who order the Application of Medicines at the Meeting of the coronal and ſagittal Sutures, ſeem yet to think that a Derivation of noxious Humours from the *Encephalon* is more eaſily procured at this Part than any other of the Scull, and that Medicines have a greater Effect here than elſewhere, in the internal Diſorders of the Head.

*OSSA TEMPORUM* *, ſo named, ſay Authors, from the Hair's firſt becoming gray on the Temples, and thus diſcovering People's Ages, are each of them equal and ſmooth above, with a very thin ſemicircular Edge; which, from the Manner of its Connection with the neighbouring Bones, is diſtinguiſhed by the Name of *Os ſquamoſum.*—— Behind this, the upper Part of the temporal Bone is thicker and more unequal, and is deſcribed by *Albinus* (*b*) as a diſtinct Part, under the Name of *Pars mammillaris.*—Towards the Baſe of the Scull the temporal Bone appears very irregular and unequal; and this Part, inſtead of being broad, and placed perpendicularly, as the others are, is contracted into an oblong very hard Subſtance, extended horizontally forwards and inwards, which in its Progreſs be-

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(*a*) Bauhin. Theat. Anat. lib. 3. cap. 6. Bartholin. Anat. Reform. lib. 4. cap. 6. Diemerbroek Anat. lib. 8. cap. 6. Kerkring. Oſteogen. cap. 2.

* Κροταφῶν, κορσῶν, κοῤῥῶν, λεπιδοειδῆ, πολυειδῆ, λιθοειδῆ, Temporalia, lapidoſa, mendoſa, dura, arcualia, tymparum, armalia, ſaxea, parietalia.

(*b*) De Oſſib. ſect. 26.

comes ſmaller, and is commonly called *Os petroſum.*

Three external Proceſſes ariſing from each of the temporal Bones are generally deſcribed. —— The firſt placed at the lower and hind Part of the Bone, from its Reſemblance to a Nipple, is called *Maſtoides* or *Mammillaris.* It is not ſolid, but within is compoſed of *Cancelli* or ſmall Cells, which have a Communication with the large Cavity of the Ear, the Drum; and therefore Sounds being multiplied in this vaulted Labyrinth, will be increaſed before they are applied to the immediate Organ of Hearing. Into the maſtoid Proceſs the *Sternomaſtoideus* Muſcle is inſerted; and to its back Part, where the Surface is rough, the *Trachelomaſtoideus* and part of the *Splenius* are fixed.---- About an Inch farther forward the ſecond Proceſs begins to riſe out from the Bone; and having its Origin continued obliquely downwards and forwards for ſome Way, it becomes ſmaller, and is ſtretched forwards to join with the *Os malæ*; they together forming the bony *Jugum*, under which the temporal Muſcle paſſes: Hence this Proceſs has been named *Zygomatic*[†]. The Fore-part of the Baſe of this Proceſs is an oblong Tubercle, which in a recent Subject is covered with a ſmooth poliſhed Cartilage, continued from that which lines the Cavity immediately behind this Tubercle. —— From the under craggy Part of the *Os temporum* the third Proceſs ſtands out obliquely forwards. The Shape of it is generally ſaid to reſemble the ancient *Stylus ſcriptorius*; and therefore it is called the *Styloid* Proceſs ‡. Some Authors (*a*) however contend, that it ought to be named *Steloid*, from its being more like to a Pillar. Several Muſcles have their Origin from this Proceſs, and borrow one half of their Name from it; as, *Stylo-gloſſus*, *Stylo-hyoideus*, *Stylo-pharyngeus*; and to it the Ligament of the *Os hyoides* is fixed. This Proceſs is often, even in Adults, not entirely oſſified, but is ſeparated at its Root from the *Os temporum*, and ſometimes is compoſed of two or three diſtinct Pieces.—— Round the Root of it, eſpecially at the Forepart, there is a remarkable Riſing of the *Os petroſum*, which ſome have eſteemed a Proceſs, and from the Appearance it makes with the *Styliform* have named it *Vaginalis*.—— Others again have, under the Name of *Auditory* Proceſs, reckoned among the external Proceſſes that ſemicircular Ridge, which running between the Root of the *maſtoid* and *zygomatic* Proceſſes, forms the Under-part of the *Meatus auditorius externus*.

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[†] Καγκρὸς, Paris, anſæ oſſium temporum, oſſa arcualia, paria, jugalia, conjugalia.

The Sinnoſities or Depreſſions on the external Surface of each *Os temporum* are theſe:—— A long *Foſſa* at the inner and back Part of the Root of the mammary Proceſs, where the poſterior Head of the *digaſtric* Muſcle has its Origin.—— Immediately before the Root of the *zygomatic* Proceſs, a conſiderable Hollow is left, for lodging the *crotaphite* Muſcle. ——Between the *zygomatic*, *auditory* and *vaginal* Proceſſes, a large Cavity is formed; thro'

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‡ Γραφοειδὴ, βελονοειδῆ, πληκτρὸν. Os calaminum, ſagittale, clavale, acuiale, calcar capitis.

(*a*) Galen. de uſu Part. lib. xi. cap. 4. Fallop. Obſerv. Anat.

the Middle of which, from Top to Bottom, a Fiſſure is obſervable, into which the Ligament that ſecures the Articulation of the lower Jaw with this Bone is fixed. The Fore-part of the Cavity being lined with the ſame Cartilage which covers the Tubercle before it, receives the *Condyle* of the Jaw; and in the Back-part a ſmall Share of the parotid Gland and a cellular fatty Subſtance are lodged.—— At the Inſide of the Root of the *ſtyloid Apophyſe*, a remarkable Cavity is found, where the Beginning of the internal jugular Vein, or End of the lateral *Sinus* is lodged.--Round the *Meatus auditorius externus* ſeveral Sinuoſities are formed for receiving the Cartilages and Ligaments of the Ear, and for their firmer Adheſion.

The *Holes* that commonly appear on the Outſide of each of theſe Bones, and are proper to each of them, are five.—— The *firſt*, ſituated between the *zygomatic* and *maſtoid* Proceſſes, is the Orifice of a large Funnel-like Canal, which leads to the Organ of Hearing; therefore is called *Meatus auditorius externus* †.—— The *Second* is the *Aquæduct* of *Fallopius*, or Paſſage for the *Portio dura* of the auditory Nerve, to be ſeen between the *maſtoid* and *ſtyloid* Proceſſes.—— Some way before, and to the Inſide of the *Apophyſis ſtyloides*, is the *Third Foramen*, the Canal from which runs firſt upwards, then forwards, and receives into it the internal *carotid* Artery, and Beginning of the intercoſtal Nerve; where this Canal is about to make the Turn forwards, one or ſometimes two very ſmall Holes go off towards the *Tympanum*; thro'

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† Πόρος ὁ ἀκουστὸς, ὀπὴ τῶν ὤτων. Feneſtra aurium.

thro' theſe *Valſalva* (a) affirms the proper Artery or Arteries of the *Tympanum* are ſent.—— On the anterior Edge of this Bone, near the former Hole, a *Fourth* is obſervable, being the Orifice of a Canal, which, in an horizontal Direction, runs outwards and backwards, till it terminates in the Cavity of the Ear, called *Tympanum*. This in the recent Subject is continued forward and inward from the Parts which I mentioned juſt now, as its Orifice in the Skeleton, to the Side of the Noſtrils, being partly cartilaginous and partly ligamentous. The whole Canal is named, *Iter à palato ad aurem*, or *Tuba Euſtachiana*.—— On the external Side of the bony Part of this Canal, and atop of the Chink in the Cavity that receives the *Condyle* of the lower Jaw, is the Courſe of the little Nerve ſaid commonly to be reflected from the lingual Branch of the fifth Pair, till it enters the *Tympanum* to run acroſs this Cavity, and to have the Name of *Chorda Tympani*.—— The *Fifth* Hole is very uncertain, appearing ſometimes behind the *maſtoid* Proceſs; ſometimes it is common to the temporal and occipital Bones; and in ſeveral Sculls there is no ſuch Hole. The Uſe of it, when found, is for the Tranſmiſſion of a Vein from the external Teguments to the lateral *Sinus*: But in ſome Subjects a Branch of the occipital Artery paſſes through this Hole, to ſerve the back Part of the *dura Mater*; in others I have ſeen two or three ſuch Holes: But they are oftner wanting than found. And we may once for all in general remark, That the Largeneſs,

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(a) De Aure humana, Cap. 2. ſect. 22. & Tab. 7. Fig. I.

Number, Situation and Exiſtence of all ſuch Holes, that for the moſt part allow only a Paſſage for Veins from without to the internal Receptacles, are very uncertain.

The internal Surface of the *Oſſa temporum* is unequal, the ſuperior circular Edge of the ſquamous Part having numerous ſmall Ridges and Furrows for its Conjunction with the parietal Bones; and the reſt of it is irregularly marked with the Convolutions of the middle Part of the Brain, and with Furrows made by the Branches of the Arteries of the *dura Mater*.

From the under Part of this internal Surface a large tranſverſe hard craggy Protuberance, runs horizontally inwards and forwards, with a ſharp Edge above, and two flat Sides, one facing obliquely forwards and outwards, and the other as much backwards and inwards. To the Ridge between theſe two Sides, the large lateral Proceſs of the *dura Mater* is fixed.

Sometimes a ſmall Bone, a-kin to the Seſamoid, is found between the ſmall Extremity of this *petrous* Proceſs and the *ſphenoid* Bone, as is remarked by *Winſlow* (*a*) after *Riolan*.

Towards the back Part of the Inſide of the *Os temporum*, a large deep *Foſſa* is conſpicuous where the *Sinus lateralis* lies, and frequently on the Top of the *petrous* Ridge, a Furrow may be obſerved, where a ſmall Sinus is ſituated.

The internal proper *Foramina* of each of theſe Bones are, *Firſt*, the *Meatus auditorius internus*

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(*a*) Expoſition Anatomique de corps humain, Traité des Os Secs, ſect. 266.

*nus*, in the poſterior plain Side of the *Proceſſus petroſus*. This Hole ſoon divides into two, one of which is the Beginning of the *Aquæduct* of *Fallopius*, the other ends in three or four, *Valſalva* (a) ſays, ſix Canals, that allow a Paſſage to the Branches of the *Portio mollis* of the ſeventh Pair of Nerves, into the *Veſtibulum* and *Cochlea*. Through it alſo an Artery is ſent, to be diſtributed to the Organ of Hearing.—— The *ſecond* Hole which is on the anterior plain Side of the craggy Proceſs gives Paſſage to a Branch of the lateral Artery of the *dura Mater*, which joins the *Portio dura* of the auditory Nerve, while it is in the *Aquæduct*; for the Diſcovery of this we are obliged to *Fallopius* (b). Frequently however a Branch of the *Portio dura*, which I ſuppoſe to be the ſame with what *Valſalva* (c) mentions, accompanied with a Branch of that Artery which went into the *Meatus auditorius* along with the acouſtick Nerve enters into the *Cranium*, here to be diſtributed to the ſoft Parts at the Side of the *Sella Turcica*.—— Near to this ſecond Hole, ſeveral ſmall ones may often be obſerved, where ſmall Arteries or Twigs of Nerves enter; on the poſterior Surface near the auditory *Foramen*, other ſmall Holes, ſome of them pretty remarkable, may be taken notice of: They ſeem only to convey Veſſels to the Subſtance of the Bone.—— The Paſſage of the cutaneous Vein into the lateral *Sinus*, is ſeen about the middle of the large *Foſſa* for that *Sinus*; and the Extremity of ſo much of the Canal of the *carotid* Artery, as is formed in this Bone, is evident at the anterior Under-part of the *petrous* Proceſs.

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(a) De aure humana, cap 3. § 11.
(b) Obſerv. Anatom.
(c) De aure, cap. 3. § 10.

Beſides theſe Holes on the external and internal Surface of each *Os temporum*, which are already deſcribed, and are proper to this Bone, there are two other in each Side, which appear both without and within the Scull, and are common to this Bone with the *Os occipitis* and *ſphenoides*, and ſhall afterwards be mentioned in the Deſcription of theſe two Bones.

The upper round Part of the ſquamous Bones is thin, but equal; while the inferior petrous Part is thick and ſtrong, but irregular and unequal, having the Diſtinction of Tables and *Diploe* confounded, with ſeveral Cavities, Proceſſes and Bones within its Subſtance, which are Parts of the Organ of Hearing. That a clear Idea may be had of this beautiful but intricate Organ, Anatomiſts generally chuſe to demonſtrate all its Parts together: I think the Method good, and therefore, ſince it wou'd be improper to inſert a compleat Treatiſe on the Ear here, ſhall omit the Deſcription of the Parts contained within the *Os petroſum* of the Skeleton.

The temporal Bones are joined above to the parietal Bones by the ſquamous Sutures, and their poſterior *additamenta:* Before, to the *ſphenoid* Bone by the Suture of that Name; to the *Oſſa malarum* by the *zygomatick* Sutures; Behind, to the *Occipital* Bone by the *Lambdoid* Suture and its *Additamenta.*

The Purpoſes which theſe two Bones ſerve, are eaſily collected from the general Uſe of the *Cranium*, and from what has been ſaid in the Deſcription of their ſeveral Parts.

In an Infant a ſmall Fiſſure is to be obſerved between the thin ſuperior Part, and the inferior craggy Part of each of theſe Bones, which points out the recent Union of theſe Parts.—Neither *Maſtoid* nor *Styloid* Proceſſes are yet to be ſeen.—Inſtead of a bony Funnel-like *meatus auditorius externus*, there is only a ſmooth bony Ring, within which the *Membrana Tympani* is faſtned.——At the Entry of the *Tuba Euſtachiana*, the Side of the *Tympanum* is not completed.—A little more outward than the internal auditory Canal, there is a deep Pit left, over the upper Part of whoſe Orifice, the interior ſemicircular Canal of the Ear is ſtretched, and ſome way below this, the poſterior ſemicircular Canal alſo appears manifeſtly.

*OS OCCIPITIS* †, ſo called from its Situation, is in the ſame Manner as the other Bones of the Scull, convex on the Outſide, and concave internally. Its Figure is an irregular Square or rather *Rhomboid*; the ſuperior Angle of which is generally a little rounded: The two lateral Angles are more finiſhed but obtuſe; and the lower one is ſtretched forward in Form of a Wedge, and thence is by ſome called the *cuneiform* Proceſs.——If one would however be very nice in obſerving the ſeveral Turns which the Edges of the *Os Occipitis* make, five or ſeven Sides and as many Angles of this Bone might be deſcribed.

The external Surface is convex, except at the cuneiform Apophyſe, where it is flatned. At the Baſe of this triangular Proceſs, on each

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† Ἰνίον, Baſilare, Proræ, Memoriæ, Pixidis, Fibroſum, Nervoſum, Lambde.

Side of the great Hole, but more advanced forwards than the middle of it, the large oblong Protuberances, named the *Condyles*, appear, to ſerve for the Articulation of this Bone with the firſt *Vertebra* of the Neck. The ſmooth Surface of each of theſe *Condyloid* Proceſſes, is longeſt from behind forwards, where by their oblique Situation they come much nearer to each other than they are at their back Part. Their interior Sides are lower than the external, by which, as *Galen (a)* well remarks, they are prevented from ſliding to either Side out of the Cavities of the firſt *Vertebra*. In ſome Subjects each of theſe plain ſmooth Surfaces ſeems to be divided by a ſmall Riſing in its Middle; and the lower Edge of each Condyle next the great *Foramen*, is diſcontinued about the Middle, by an interveening Notch, which gave *Diemerbroek (b)* Ground to alledge, that each of theſe *Apophyſes* was made up of two Protuberances.—Round their Root a ſmall Depreſſion and ſpongy Roughneſs is obſervable, where the Ligaments for ſurrounding and ſecuring the Articulations adhere.—— Concerning theſe *Condyles* it is to be remarked, that tho' the Motion of the Head is performed on them, yet the Center of Gravity of that Globe does not fall between them, but is a good Way further forward; by which Mechaniſm it is evident, that the Muſcles which pull the Head back, muſt be in a conſtant State of Contraction, which is ſtronger than the natural Contraction of the proper Flexors; elſe the Head would always fall forwards, as it does when a Man is aſleep, or labours under a Palſy, as well as in all Infants, where the Weight of the Head far exceeds the proportional Strength of theſe Muſcles. This ſeeming diſadvantageous Situation of theſe Condyles is however of good Uſe to us, by allowing ſufficient Space for the Cavities of the Mouth and *Fauces*, and for lodging a ſufficient Number of Muſcles, which commonly ſerve for other Uſes, but may at pleaſure be directed to act on the Head, and then have an advantageous Lever to act with, ſo as as to be able to ſuſtain a conſiderable Weight appended, or other Force applied, to pull the Head back.

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(a) De uſu part. lib. 12. cap. 7.
(b) Anat. lib. 9. cap 6.

Somewhat more externally than the *Condyloid* Proceſſes, we remark on the occipital Bone a ſmall Riſing and ſemilunated Hollow in each Side, which make up Part of the *Foramina* common to this Bone with the *oſſa petroſa.* Immediately behind this on each Side, a ſcabrous Ridge is extended from the Middle of the Condyle towards the Roots of the *Maſtoid* Proceſs: Into this Ridge the *Muſculus lateralis*, commonly aſcribed to *Fallopius*, is inſerted.——About the Middle of the external convex Surface, a large Arch runs croſs the Bone, from the upper Part of which, towards the Sides of the Head, the *Muſculi occipitales* have their Riſe; to its Middle the *Trapezii* are attached; and into the lower Part of it, ſome tendinous Fibres of the *Complexi* and *Splenii* are fixed.—— In the Hollows immediately below the Middle of this Arch, the *Complexi* are inſerted, and in the Depreſſions more external than theſe, the *Splenii* are inſerted.——Below theſe, an oblique Ridge is extended, to which the exterior Fibres of the *recti majores* and of the ſuperior oblique

Muſcles are fixed, and the fleſhy Inſertions of theſe Muſcles make Depreſſions below this. —Lower ſtill, and nearer the Middle of the Bone, the little hollow Marks of the *recti minores* appear.—Through the Middle of the two Arches a ſmall ſharp *Spine* runs, which ſerves as ſome Sort of Partition between the Muſcles of different Sides, or rather is owing to the Action of the Muſcles depreſſing the Bone on each Side of it, while this Part is free from their Compreſſion.——Theſe Prints of the Muſcles on this Bone are very ſtrong and plain in ſome Subjects, but are not ſo diſtinct in others.—All round the great *Foramen* the Edges are unequal, for the firmer Adheſion of the ſtrong circular Ligament, which goes thence to the firſt *Vertebra*.——One End of each *lateral* or *moderator* Ligament of the Head is fixed to a rough Surface at the fore Part of each Condyle, and the *perpendicular* one is connected to a rough Part of the Edge of the great Hole between the two Condyles.—— Immediately before the Condyles, two little Depreſſions are made in the external Surface of the cuneiform Proceſs, for the Inſertion of the *Musculi recti anteriores minores*, generally, tho' unjuſtly, alledged to be firſt diſcovered by *Cowper*. And ſtill further forward, nearer the *ſphenoid* Bone, are two other ſuch Depreſſions, for the Reception of the *Recti anteriores majores*.—— When we conſider the Size of the Prints of Muſcles on the occipital Bone before and behind its Condyles, and at the ſame time compare their Diſtances from theſe Centres of Motion of the Head, we muſt ſee how much ſtronger the Muſcles are which pull the Head backwards, than thoſe are which bend it forward, and how much greater Force the former acquire by the long Lever they act with, than the latter which are inſerted ſo near the Condyles. This great Force in the extenſor Muſcles is altogether neceſſary that they might not only keep the Head from falling forward in an erect Poſture, but that they might ſupport it when we bow forward in the moſt neceſſary Offices of ſocial Life, when the Weight of the Head comes to act at right Angles on the Vertebræ of the Neck and obtains a long Lever to act with.

On the inner Surface of the *Os occipitis*, we ſee two Ridges, one ſtanding perpendicular, the other running horizontally acroſs the firſt. The upper Part of the perpendicular Limb of the Croſs to which the *Falx* is fixed, is hollowed in the Middle, or often in one Side, for the Reception of the *Sinus longitudinalis ſuperior*; and the lower Part of it has the ſmall or third Proceſs of the *dura Mater* faſtned to it, and is ſometimes hollowed by the occipital Sinus. Each Side of the horizontal Limb is made hollow by the lateral Sinuſes incloſed in the tranſverſe Proceſs of the *dura Mater*, the *Foſſa* in the right Side being generally a Continuation of the one made by the longitudinal Sinus in the perpendicular Limb.——Round the Middle of the Croſs there are four large Depreſſions ſeparated by its Limbs; the two ſuperior being formed by the back Part of the Brain, and the two inferior by the *Cerebellum*.——Farther forward than the laſt mentioned Depreſſions, is the lower Part of the *Foſſa* for the lateral *Sinus* on each Side.—The inner Surface of the cuneiform Apophyſe is made concave for the

Reception of the *Medulla oblongata*, and a Furrow, remarked by *Albinus (a)*, is made on each Side, near the Edges of this Proceſs, by a *Sinus* of the *dura Mater*, which empties itſelf into the lateral *Sinus*.

The Holes of this Bone are commonly five proper, and two common to it and to the *Oſſa temporum*.——The firſt of the proper Holes is the large round one immediately behind the Wedge-like Proceſs, which allows a Paſſage to the *Medulla oblongata*, *Nervi acceſſorii*, to the vertebral Arteries, and ſometimes to the vertebral Veins; *Foramen magnum occipitis* † is the Name this generally obtains.——At each Side of this great Hole, near its fore Part, we always find a Hole, ſometimes two, which ſoon unite again into one that opens externally, immediately above the *Condyloid* Proceſſes; thro theſe the ninth Pair of Nerves go out of the Scull.——The fourth and fifth Holes are theſe, that on each Side pierce from behind the *Condyles* into the *Foſſæ* of the lateral *Sinuſes*; they ſerve for the Paſſage of the cervical Veins to theſe *Sinuſes:* Often one of theſe Holes is wanting, ſometimes both, when the Veins paſs through the great *Foramen*.——Beſides theſe five, we frequently meet with other Holes near the Edges of this Bone, for the Tranſmiſſion of Veins; their Number and Diameter is very uncertain, tho' they are ſometimes very large.——The two common *Foramina* are theſe large irregular Holes, one in each Side, between the Sides of the *Proceſſus cuneiformis*, and

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(*a*) De oſſib. § 65.

† Rachitidis, Medullæ ſpinalis.

and the Edges of the *Oſſa petroſa*. In a recent Subject, a ſtrong Membrane runs croſs from one Side to the other of each of theſe Holes; and in ſome Heads I have ſeen this Membrane oſſified, or a bony Partition dividing each Hole; and in the greater Number of adult Sculls there is a ſmall ſharp-pointed Proceſs ſtands out from the *Os petroſum*, and a more obtuſe Riſing in the occipital Bone beween which the Partition is ſtretched. Behind this *Septum*, where the largeſt Space is left, the *Sinus lateralis* has its Paſſage; and before it the eight Pair of Nerves and *Acceſſorius* make their Exit out of the Scull; and ſome Authors ſay, an Artery paſſes through this Hole to be beſtowed on the *dura Mater*.

The *Os Occipitis* is among the thickeſt Bones of the *Cranium*, tho' unequally ſo; for it is ſtronger above, where it has no other Defence than the common Teguments, than it is below, where being preſſed by the Lobes of the Brain and *Cerebellum* on one Side, and by the Action of the Muſcles on the other, it is ſo very thin, as to be diaphanous in many Sculls: But then theſe Muſcles ward off any Injury, and the Ridges and Spines which are frequent here, make it ſufficiently ſtrong to reſiſt any ordinary Force. The Tables and *Diploe* are tolerably diſtinct in this Bone, except where it is ſo thin as to become diaphanous.

The occipital Bone is joined above to the *Oſſa parietalia* and *Triquetra* when preſent, by the *Lambdoid* Suture;—laterally to the *Oſſa temporum*, by the *Additamenta* of the *Lambdoid* Suture; — below to the *ſphenoid* Bone by the Extremity of its own cuneiform Proceſs, in the ſame Way that Epiphyſes and their Bones are joined: For in Children a ligamentous Cartilage is interpoſed between the occipital and ſphenoid Bones, which gradually turns thinner as each of the Bones advances till their Fibres at laſt run into each other; and about ſixteen or eighteen Years of Age the Union of theſe two Bones becomes ſo intimate that a Separation cannot be made without Violence.—— The *Os occipitis* is articulated below with the firſt *Vertebra* of the Neck, by what I have deſcribed as the third or long *Species* of *Ginglimus*; for each Condyle is received into a ſuperior oblique Proceſs of that *Vertebra*. What Motion is allowed here, we ſhall conſider afterwards, where the *Vertebræ* are deſcribed.

The Uſes of this Bone appear from the preceeding Deſcription, and therefore need not be repeated.

An Infant born at the full Time, has this Bone divided by unoſſified Cartilages, into four Parts.—— The firſt of theſe is larger than the other three, is of a triangular Shape, and conſtitutes all the Part of the Bone above the great *Foramen*; generally Fiſſures appear in the upper Part and Sides of this triangular Bone, when all the Cartilage is ſeparated by Maceration; and ſometimes little diſtinct Bones are ſeen towards the Edges of it.—— The ſecond and third Pieces of this Bone are exactly alike, and ſituated on each Side of the great *Foramen*, from which, very near the whole Condyles are produced, and they are extended forwards almoſt to the anterior Side of the Hole for the ninth Pair of Nerves.—— The fourth Piece is the cuneiform Proceſs, which forms a ſmall Share of the great *Foramen*, and of the Condyles;

dyles; betwixt it and the *ſphenoid* Bone a Cartilage is interpoſed.

There are only two Bones of the eight which belong to the *Cranium*, now left undeſcribed, *viz.* the *Ethmoid* and *Sphenoid.* Theſe we already mentioned, in Complaiſance to the Generality of Writers on this Subject, as Bones common to the *Cranium* and Face, becauſe they enter into the Compoſition of both, as we ſhall ſee they indeed do. The ſame Reaſon might equally be uſed for calling the frontal Bone a common one too. But I ſhall paſs any idle Diſpute about the Propriety of ranging them, and proceed to examine the Structure of the Bones themſelves.

*OS ETHMOIDES* *, or the Sieve-like Bone, has got its Name from the great Number of ſmall Holes with which that Part of it firſt taken notice of and deſcribed, is pierced. When this Bone is entire, the Figure of it is not eaſily deſcribed, but by a Detail of its ſeveral Parts, ſome Idea may be afforded of the whole; and therefore I ſhall diſtinguiſh it into the *Cribriform lamella* with its Proceſs, the *Naſal lamella*, *Cellulæ*, and *Oſſa ſpongioſa.*

The internal, plain, thin, horizontal *Lamella*, with a middle perpendicular Protuberance called *criſta galli* †, from its Reſemblance to a Cock's Comb, is univerſally known.—— Round this Proceſs, except at the back Part, the *Lamella* is perforated obliquely by a great Number of ſmall Holes, through which the Filaments of the olfactory Nerves paſs. In a recent Subject theſe *Foramina* are ſo cloſely lined by the *dura Mater*, that they are much leſs conſpicuous than in the *Skeleton.*—— The *Criſta galli* is much thicker and ſtronger than the Baſe it is ſupported by, and ends in a Ridge ſloping backwards and downwards, to which, and the poſterior unperforated Part of the *Lamella*, the Beginning of the *Falx* is connected. Immediately before the higheſt Part of this Proceſs, is the blind Hole of the *Os frontis*, which, as we remarked before, is often in a good Meaſure formed by a Notch in the anterior Edge of the *Criſta.*

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* Cribriforme σπογγοειδὴς, Spongiforme.

† Verruca prædura, ſeptum oſſis ſpongioſi.

From the middle of this *Cribriform Lamella*, a thin ſolid perpendicular Proceſs ſtands out externally, reſting on the ſame common Baſe with the *Criſta galli*; though for moſt Part this external Plate is not entirely perpendicular, but inclined to one Side or other, and therefore divides the Cavity of the Noſe unequally. ——This *naſal Lamella* is thin at its Riſe, and rather ſtill thinner in its Middle, yet afterwards towards its anterior Edge it becomes thicker, that its Conjunction with the Bones and middle Cartilage of the Noſe might be firmer.—Hence we may ſee, that if the Bones of the Noſe are broken by a Force applied in a perpendicular Direction to this Plate, the cribriform *Lamella* may be in great Danger, and conſequently ſuch a Fracture may prove fatal.

At a little Diſtance from each Side of this external Proceſs, a cellular and ſpongy bony Subſtance is conſpicuous. The Number and Figure of the Cells in this irregular Proceſs of each Side, are very uncertain, and not to be repreſented in Words; only the Cells open into each other, and into the Cavity of the Noſe, the ſuperior, which are below the Aperture of the frontal *Sinuſes*, are formed like a Funnel.—— The outer Surface of theſe Cells is ſmooth and plain, where this Bone aſſiſts in compoſing the Orbit, at which Place on each Side it has got the Name of *Os planum*, on the upper Edge of which, a ſmall Notch or two are ſometimes obſerved, which go to the Formation of the *Foramina orbitaria interna*, as was remarked in the Deſcription of the *Os frontis*.

The *ſpongy Bones* are on the lower internal Part of theſe *Cellulæ*; their Figure is ſomewhat elliptical, only each terminates in two ſharp Extremities, one of which points obliquely backwards, and the other forwards.—— The Extent of theſe Bones is marked on their outſide, where they are concave, by a deep Furrow ſurrounding their Baſe.—— Their internal Surface next the *Septum naſi* is convex.— Theſe two Proceſſes of the *Ethmoid* Bone have, from their Subſtance, Figure and Situation, got the Name of *Oſſa ſpongioſa*, or *Turbinata ſuperiora*.

All the Prominencies, Cavities and *Meanders* of this *ethmoid* Bone, are covered with a Continuation of the Membrane of the Noſtrils, in a recent Subject.——The horizontal cribriform *Lamella* of this Bone is lodged between the orbitar Proceſſes of the *frontal* Bone, to which it is joined by the *ethmoid* Suture, except at the back Part, where it is articulated with the *Cuneiform*, by a Suture common to both the Bones, though it is generally eſteemed Part of the *Sphenoidal*.— Where the *Oſſa plana* are contiguous to the frontal Bone within the Orbit, their Conjunction is reckoned Part of the tranſverſe Suture.—— Farther forward than the *Oſſa plana*, the Cells are covered by the *Oſſa unguis*, which are not only contiguous to theſe Cells, but cannot be ſeparated from them, without breaking the bony Subſtance; and therefore in Juſtice, thoſe Bones ought to be demonſtrated as Part of the *Ethmoid* Bone. —— Below the *Oſſa unguis* and *plana* theſe Cells, and *Oſſa ſpongioſa* are overlop'd by the *Oſſa maxillaria*.—— The cellular Part of the *Oſſa palati* is contiguous to the *Oſſa plana* and Cells backwards.—The lower Edge of the Naſal perpendicular *Lamella* is received into a Furrow of the *Vomer* by *Schindyleſis*.— Its poſterior Edge is joined to the Fore-part of the *Proceſſus azygos* of the *ſphenoid* Bone.— Its upper Edge joins the *Naſal* Proceſs of the *Os frontis* and *Oſſa naſi*, and its anterior one is connected to the middle Cartilage of the Noſe.

From all which the Uſes of this Bone are evident, *viz.* to ſuſtain the anterior Lobes of the Brain; to allow the olfactory Nerves a ſafe Paſſage, and the *Falx* a firm Attachment; to enlarge the Organ of Smelling, by allowing the Membrane of the Noſe a greater Extent; to ſtraiten the Paſſage of the Air through the Noſe, by leaving only a narrow winding Canal, on the ſenſible membranous Sides of which all the Subſtances conveyed along with the Air, muſt ſtrike; to form Part of the Orbit of the Eyes and *Septum narium*, while all its Parts are ſo light, as not to be uneaſy, or in hazard of ſeparating by their Weight, and ſo thin as to form a large Surface, without occupying much Space; and at the ſame Time this brittle Subſtance is ſufficiently protected from external Injuries by the firm Bones which cover it.

If this Bone is ſeized on by any corroding Matter, we may eaſily conceive what Deſtruction may enſue. Hence it is, that an *Ozæna* is ſo difficult to cure, and that in violent *Scurvies*, or in the *Lues Venerea*, the Fabrick of the Noſe, the Eyes, and Life itſelf are in ſo much Danger.

The *Ethmoid* Bone of ripe Children is divided into two by a perpendicular Cartilage, which when oſſified is the *Criſta Galli* and naſal *Lamella*.

*OS SPHENOIDES* †, or Wedge-like Bone, ſo called becauſe by its Situation in the middle of the Bones of the *Cranium* and Face, it bears, ſay Authors, ſome Analogy to that Inſtrument, is of a very irregular Figure, nor do I know any thing to which it may be likened, unleſs perhaps it bear ſome faint Reſemblance to a Bat with its Wings extended.

When we view the Outſide of the *Os ſphenoides*, five remarkable Proceſſes may be obſerved, which are all of them again ſubdivided. —The firſt and ſecond are the two large lateral *Apophyſes* or Wings; the ſuperior Part of each of which is called the *Temporal Proceſs*, becauſe they join with the temporal Bones in forming the Temples, and Seat for ſome Share of the *crotaphite* Muſcles: That Part of the lateral Proceſſes which jutts out towards the Inſide, ſomewhat lower than the temporal *Apophyſes*, and is ſmooth and hollowed, where it makes up Part of the Orbit, is thence named *Orbitar Proceſſes*. Behind the Edge ſeparating theſe two Proceſſes there is often a ſmall Groove, made by a Branch of the ſuperior maxillary Nerve in its Paſſage to the temporal Muſcle. The loweſt and back Part of each Wing, which runs out ſharp to meet the *Oſſa petroſa*, has been ſtiled *Apophyſes ſpinoſæ:* From near the Point of which a ſharp-pointed Proceſs is frequently produced downwards, which ſome call *Styliform*, that affords Origin to the *Ptery-ſtaphylinus externus* Muſcle. From this ſtyloid Proceſs a very ſmall Groove is extended along the Edge of the Bone to the Hollow at the Root of the more internal Plate of the following Proceſſes, which *Winſlow* (a) rightly deſcribes as Part of the *Euſtachian* Tube.—— The third and fourth external Proceſſes of the *cuneiform* Bone, are the two which ſtand out almoſt perpendicular to the Baſe of the Scull. Each of them has two Sides and a middle *Foſſa* facing backwards, and ſhould, to carry on our Compariſon, be likened to the Bat's Legs, but are commonly ſaid to reſemble the Wings of that Creature; and therefore are well known by the Name of *Pterygoid* or *Aliform* † Proceſſes. The two Sides of each are called *Alæ* or Wings: The external are broadeſt, and the internal longeſt. From each Side of the external *Ala* the *pterygoid* Muſcles take their Riſe. At the Root of each internal Wing a ſmall Hollow may be remarked, where the *Muſculus ptery-ſtaphylinus internus* riſes, and ſome Share of the cartilaginous Extremity of the *Tuba Euſtachiana* reſts; and at the lower Extremity of the ſame Wing is a Hook-like Riſing or Proceſs, round which the Tendon of the laſt-named Muſcle plays, as on a Pulley. From the Edge of the external Wings ſome ſmall ſharp Spikes ſtand out; but their Number and Bulk are uncertain.—— The fifth external Proceſs of the *ſphenoid* Bone is that ſharp middle Ridge which ſtands out from the Baſe of this Bone: Becauſe it wants a Fellow, it may be called *Proceſſus azygos*. The lower Part of this Proceſs, where it is received into the *Vomer*, is thick, and often not quite perpendicular, but inclining more to one Side than the other. The Forepart of this Proceſs, where it joins the naſal *Lamella* of the *Os Ethmoides*, is thinner and ſtreighter. Theſe two Parts have been deſcribed as two diſtinct Proceſſes by ſome.

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† Cuneiforme, πολύμορφον, multiforme, paxillum, cribratum, palati, colatorii, cavilla, baſilare.

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(a) Expoſition Anatomique du corps humain traité des Os ſecs, Sect. 233.

† Naviculares.

The Depreſſions, Sinuoſities and *Foſſæ* on the external Surface of this *ſphenoid* Bone, may be reckoned up to a great Number, *viz*. Two on the temporal *Apophyſes*, where the *crotaphite* Muſcles lodge;—— Two on the *orbitar* Proceſſes, to make way for the Globes of the Eyes.—— Two between the *temporal* and *ſpinous Apophyſes*, for receiving the temporal Bones.—— Two between the Wings of the *pterygoid* Proceſſes, where the *Muſculi pterygoidei interni* and *Ptery-ſtaphylini interni* are placed.—— Two between the *pterygoid* and *orbitar* Proceſſes, for forming the Holes common to this Bone, and to the *Oſſa malarum* and *maxillaria*.—— Two on the inferior Extremities of the *aliform* Proceſſes, which the *Oſſa palati* enter into.—— Two at the Roots of the *temporal* and *pterygoid* Proceſſes, where the largeſt Share of the external *pterygoid* Muſcles have their Riſe.—Two at the Sides of the *Proceſſus azygos*, for forming Part of the Noſe, &c.

What I deſcribed under the Name of *temporal* and *ſpinous Proceſſes* on the Outſide of the Skull, are likewiſe ſeen on its In-ſide, but concave, and commonly three *Apophyſes* on the internal Surface of the *ſphenoid* Bone are only mentioned.——Two riſing broad from the Fore-part of its Body, become ſmaller as they are extended obliquely backwards.—— The third ſtanding on a long tranſverſe Baſe near the Back-part of the Body of this Bone, riſes nearly erect, and of an equal Breadth, terminating often in a little Knob on each Side. The three are called *Clinoid*, from ſome Reſemblance which they were thought to have to the Supporters of a Bed. Sometimes one or both the anterior *clinoid* Proceſſes are joined to the Sides of the poſterior one, or to the Body of the Bone itſelf.— From the Roots of the anterior *clinoid* Proceſſes the Bone is extended on each Side outwards and forwards, till it ends in a ſharp Point, which may have the Name of the *tranſverſe ſpinous* Proceſſes. —†—Between, but a little farther back than the two anterior *clinoid* Proceſſes, we ſee a Protuberance conſiderably ſmaller than the poſterior *clinoid* Proceſs, but of its Shape. Another Protuberance often forces itſelf forwards into the *Os Ethmoides*, from between the tranſverſe Proceſſes.

Within the Scull there are two Sinuoſities in the internal Part of each Wing of the *ſphenoid* Bone, for receiving the middle Part of the Brain.—— One between the tranſverſe ſpinous Proceſſes, for lodging the *Crura medullæ oblongatæ*.—— Immediately before the third or middle *clinoid* Proceſs, a ſingle Pit generally may be remarked, from which a *Foſſa* goes out on each Side to the *Foramina optica* of this Bone. The Pit is formed for the conjoined optick Nerves; and in the *Foſſæ* theſe Nerves are lodged, as they run divided within the Skull. ——Between that third Protuberance and the poſterior *clinoid* Proceſs, the large Pit for the *Glandula pituitaria* may be remarked. This Cavity, becauſe of its Reſemblance to a *Turkiſh* Saddle, is always deſcribed under the Name of *Sella Turcica* or *Ephippium*.—— On the Sides of the poſterior *clinoid* Proceſs a *Foſſa* may be remarked, that ſtretches upwards, then is continued forwards along the Sides of the *Sella Turcica*, near to the anterior *clinoid* Proceſſes, where a Pit on each Side is made. Theſe *Foſſæ* point out the Courſe of the two *carotid* Arteries after they have entred the Scull.—— Beſides all theſe, ſeveral other *Foſſæ* may be obſerved, leading to the ſeveral *Foramina* and imprinted by the Nerves and Blood-veſſels.

The *Foramina* of the *Os ſphenoides* are on each Side, ſix proper, and three common.—— The *Firſt* is the round Hole immediately below the anterior *clinoid* Proceſſes, for the Paſſage of the optick Nerve, and of the Branch of the internal *carotid* Artery that is ſent to the Eye.—— The *ſecond* is the *Foramen lacerum* or large Slit between the tranſverſe ſpinous and orbitar Proceſſes: The interior Extremity of which Slit is large; and as it is extended outwards, it becomes narrower, and at laſt the outer End of it is formed out of the *Os frontis*: Therefore this might be reckoned among the common *Foramina*. Through it the *Nervi motores*

*tores oculi*, *Pathetici*, and firſt Branch of the fifth, the whole ſixth Pair of Nerves, except one reflected Branch, according to the moſt common Deſcriptions of the Nerves, and an Artery from the internal Carotid, go into the Orbit. Sometimes a ſmall Branch of the external Carotid, deſcribed by *Winſlow (a)*, enters near its Extremity, to be diſtributed to the *dura Mater*; and a Vein, ſome call it *Ductus Venoſus*, or *Nuck's Aquæduct*, returns to the ſuperior petroſal *Sinus*.—— The *Third* Hole is a round one behind the former, allowing a Paſſage to the ſecond Branch of the fifth Pair of Nerves, or ſuperior maxillary Nerves, into the Bottom of the Orbit. To diſtinguiſh this Hole, Authors have, from its Figure, given it the Name of *Foramen rotundum*.—— The *Fourth* is the *Foramen ovale*, about half an Inch behind the round Hole. Through it the third Branch of the fifth Pair of Nerves, or *maxillaris inferior*, goes out; and ſometimes I have ſeen a Vein from the *dura Mater* paſſing out here, as obſerved by *Ingraſſias (b)*.——Very near the Point of the ſpinous Proceſs, the *Fifth* Hole of this Bone appears: It is ſmall and round, for a Paſſage to the largeſt Artery of the *dura Mater*, which often is accompanied with a Vein.—— The *Sixth* proper Hole ſeems to be mentioned by *Veſalius* (*c*), and is obſcurely painted by *Euſtachius* (*d*); but is, in my Opinion, firſt fully deſcribed and delineated by *Vidus Vidius*

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(*a*) Expoſition Anatomique de corps humain, Traité des Arteres Sect. 60. & De la Tete ſect. 26.

(*b*) Commentar. in Galen. de Oſſib. lib. 1. comment. 8.

(*c*) Anat. lib. 1. cap 12.

(*d*) Tab. 46. fig. 13 & 16.

*Vidius* (*a*), and has been neglected by Anatomiſts till of late. It is not well to be ſeen, till the cuneiform Bone is ſeparated from all the other Bones of the *Cranium*; for the Beginning of it is hid by a ſmall Protuberance of the internal *Ala pterygoidea*, and by the Extremity of the *Proceſſus petroſus* of the *Os temporum*. It runs above the inner Wing of the *pterygoid* Proceſs, and where it opens into the Cavity of the Noſe, is concealed by the thin laminous Part of the *Os palati*. Through it an Artery from the external *Carotid* runs, to be diſtributed to the Noſtrils: So that as this Hole does not open within the *Cranium*, it differs from all the other *Foramina* of this Bone already deſcribed. In ſeveral Subjects, ſoon after the Entry of this Artery, a ſmall Branch goes backwards from it to the *Foſſa pterygoidea*, and a ſecond enters the Scull to ſerve the *dura Mater*.— Often in the Middle of the *Sella Turcica* a ſmall Hole or two appear, piercing as far as the cellular Subſtance of the Bone; and ſometimes at the Sides of this *Sella* one or more ſmall Holes penetrate into the *Sinus ſphenoidales*. Theſe Obſervations afforded *Sylvius* (*b*) and *Laurent* (*c*) an Argument of ſome Weight in thoſe Days in defence of *Galen* (*d*), to prove the Deſcent of the *Pituita* that Way into the *Sinuſes* below.

The *Firſt* of the common Holes is that unequal Fiſſure at the Side of the *Sella Turcica*, be-

tween

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(*a*) De Anat. lib. 2. cap. 2. Explic. tab. 5. & tab. 5. fig. 8, 9, 10. lit. O.

(*b*) Calumniæ ſecundæ amolitio.

(*c*) Hiſt. Anat. lib. 2. quæſt. 11.

(*d*) De uſu Part. lib. 9.

tween the extreme Point of the *Os petroſum* and the *Proceſſus ſpinoſus* of the cuneiform Bone. This Hole only appears after the Bones are boiled; for in a recent Subject a conſiderable Part of it is covered by a thin bony Plate that lies over the internal carotid Artery, and the anterior Part is filled with a cartilaginous Ligament, under which the cartilaginous Part of the *Tuba Euſtachiana* is placed: Sometimes however a Branch of that Artery which enters the ſixth *Foramen pterygoideum* is ſent through this Subſtance to the *dura Mater*. It was by this Paſſage that the Ancients believed the *Pituita* was conveyed from the Emunctory of the Brain, the *Glandula pituitaria*, to the *Fauces*.— The *Second* common Hole is that large Diſcontinuation of the external Side of the Orbit, left between the orbitar Proceſſes of the cuneiform Bone, the *Os maxillare*, *Malæ* and *Palati*. In this large Hole the Fat for lubricating the Globe of the Eye and temporal Muſcle is lodged, and Branches of the Superior maxillary Nerve, with ſmall Arteries from the Carotid and Veins paſs. —The *third* Hole is formed between the Baſe of this Bone and the Root of the orbitar Proceſs of the Palate-bone of each Side. Through this a Branch of the external carotid Artery, and of the ſecond Branch of the fifth Pair of Nerves, are allowed a Paſſage to the Noſtrils, and a returning Vein accompanies them. Sometimes however this Hole is proper to the Palate Bone, being entirely formed out of its Subſtance.

Under the *Sella Turcica*, and ſome Way farther forward, but within the Subſtance of the *ſphenoid* Bone, are two *Sinuſes*, ſeparated by a bony Plate, much a-kin to thoſe of the *Os frontis*. Each opens into the upper and back Part of each Noſtril by a round Hole, which is at their upper anterior Part. This Hole is not formed only by the *Os ſphenoides*, which has an Aperture near as large as any tranſverſe Section of the *Sinus*, but alſo by the *Oſſa palati*, which are applied to the Fore-part of theſe *Sinuſes*, and cloſe them up, that Hole only excepted, which was already mentioned. Frequently the two *Sinuſes* are of unequal Dimenſions, and ſometimes there is only one large Cavity, with an Opening into one Noſtril. *Albinus (a)* has deſcribed theſe Cavities, extended ſometimes as far back as the great *Foramen* of the occipital Bone. In other Subjects they are not to be found, when, as *Veſalius (b)* obſerves, the Bone is compoſed of large Cells. The ſame Author alſo deſcribes a Cavity within the Partition of the *Sinuſes*; but this ſeldom is any thing remarkable. Theſe *Sinuſes* are lined with the ſame ſort of Membrane, and ſerve the ſame Uſes as the frontal *Sinuſes*.

As this Bone is extremely ragged and unequal, ſo its Subſtance is very different, being in ſome Places diaphanous, in others of a middle Thickneſs, and its middle poſterior Part ſurpaſſing the greateſt Share of the *Cranium* in Thickneſs.

The *Os ſphenoides* is joined, by its Wings, to the *Oſſa parietalia* above, to the *Os frontis* and *Oſſa malarum* before, to the *Oſſa temporum* behind;— by the anterior Part of its Body and ſpinous Proceſſes, to the *Os frontis* and *Ethmoides*;——

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(a) De Offib. ſect. 39.
(b) Lib. I. cap. 6.

*des*; —— by its back-part, behind the two *Sinuſes*, to the *Os occipitis*, where it looks like a Bone with the *Epiphyſes* taken off, and, as was formerly obſerved in the Deſcription of the occipital Bone, it is not to be ſeparated without Violence in Adults; —— to the *Oſſa palati*, by the Extremities of the *pterygoid* Proceſſes, and ſtill more by the anterior Part of the internal *Alæ*, as alſo by the Fore-part of the *Sinuſes*; —— to the *Oſſa maxillaria*, by the anterior Part of the external *Alæ*; — to the *Vomer* and naſal *Lamella* of the *Os Ethmoides*, by the *Proceſſus azygos*. All theſe Conjunctions, except the laſt, which is a *Schindyleſis*, are ſaid to be by means of the Suture proper to this Bone; tho' it is at firſt Sight evident, that ſeveral other Sutures, as the *tranſverſe*, *ethmoidal*, &c. are confounded with it.

We ſee now how this Bone is joined to all the Bones of the *Cranium*, and to moſt of the upper Jaw; and therefore obtained the Name of the *Wedge-like Bone*.

The Uſes and Deſcription are ſo blended, as to leave nothing new to be added.

The *ſphenoid* Bone is almoſt complete in a *Fœtus* of nine Months, only the great *Alæ* ſeparate after Maceration from the Body of the Bone.-- The *Proceſſus azygos* is very large and hollow; — The internal Surface of the Body is unequal and porous; -- The *Sinuſes* do not appear.

Whoever is acquainted with each Bone of the *Cranium*, can, without Difficulty, examine them as they ſtand united, ſo as to know the Shapes, Sizes, Diſtances, &c. of their ſeveral Parts, and the Forms, Capacities, &c. of the

Cavities formed by them, which is of great Uſe towards underſtanding the Anatomy of the Parts contiguous to, contained within, or connected to them. Such a Review is neceſſary, after conſidering each Claſs of Bones. Thus the Orbits, Noſtrils, Mouth, Face, Head, Spine, *Thorax*, *Pelvis*, Trunk, Extremities and Skeleton ought likewiſe to be examined.

The *FACE* is that irregular Pile of Bones at the anterior and inferior Part of the Head, which is divided by Authors into two *Maxillæ* or Jaws, Upper and Lower.

The *Superior Maxilla* † is the common Deſignation given to the upper immoveable Share of the Face; tho', if we would follow *Celſus* (*a*), we ſhould apply the Word *Maxilla* to the lower Jaw only, and uſe the Name *Mala* for this upper Jaw. In Complaiſance to prevailing Cuſtom, I ſhall however follow the Terms now commonly employed. The Shape of the ſuperior *Maxilla* cannot eaſily be expreſſed; nor is it neceſſary, provided the Shape and Situation of all the Bones which compoſe it are deſcribed. It is bounded above by the tranſverſe Suture, behind by the Fore-part of the *ſphenoid* Bone, and below by the Mouth.

The upper Jaw conſiſts of ſix Bones on each Side, of a thirteenth Bone which has no Fellow, placed in the middle, and of ſixteen Teeth. The thirteen Bones are, two *Oſſa naſi*, two *Oſſa unguis*, two *Oſſa malarum*, two *Oſſa maxillaria*, two *Oſſa palati*, two *Oſſa ſpongioſa inferiora*, and the *Vomer*.

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† Σιαγων, γένυς, Mandibula.

(*a*) Lib. 8. cap. 1.

The *Oſſa naſi* are placed at the upper Part of the Noſe;—— the *Oſſa unguis* at the internal *Canthi* of the Orbits;—— *Oſſa Malarum* form the Prominence of the Cheeks;—— *Oſſa maxillaria* form the Side of the Noſe, with the whole lower and Fore-part of the upper Jaw, and the greateſt Share of the Roof of the Mouth:—— *Oſſa palati* are ſituated at the back Part of the Palate, Noſtrils and Orbit;——*Oſſa ſpongioſa* are ſeen in the lower Part of the *Nares*;— and the *Vomer* helps to ſeparate theſe two Cavities.

Theſe Bones of the upper Jaw are all, except the *Vomer*, and perhaps the *Oſſa ſpongioſa*, joined to the Bones of the *Cranium*, and to each other by Sutures; the Indentations of which are not very conſpicuous externally, but plainly appear when the Bones are taken aſunder, though they are not near ſo large as thoſe of the Scull, where there is greater Neceſſity for Security againſt both external Injuries and an extruding internal Force.——In aged Sculls the Sutures of the upper Jaw are frequently deſtroyed, for the Bones then grow together; which can be of little Prejudice, ſince the greateſt Uſe of any Separation here ſeems to be to allow the Bones to be duly extended. Authors have generally diſtinguiſhed theſe Sutures by Numbers; but I would rather chuſe, with ſome Writers (*a*) to aſſign particular Names to them; which might be eaſily contrived from their Situation, or from the Bones they connect.

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(*a*) Vander Linder Medicin. phyſiolog. cap. 13. art. 2. § 10. Rolfinc. Anat. lib. 2. cap. 35. Schenk. Schol. part. ult. par. 2. cap. 5.

One muſt at firſt View ſee, from the Manner of the Conjunction of theſe Bones, that they can have no Motion, except in common with the *Cranium*.

The Purpoſes which this Pile of Bones ſerves, will ſufficiently appear in the particular Deſcriptions which ſhall be given of each, in the ſame Order in which they were already ranged.

*OSSA NASI*, ſo named from their Situation at the Root of the Noſe, are each of an irregular oblong ſquare Figure, being broadeſt at their loweſt Extremity, narroweſt a little higher than their Middle, and becoming ſomewhat larger at the Top, where they are ragged and thickeſt, and have a Curvature forwards, that their Connexion with the *Os frontis* might be ſtronger.

The lower Edge is unequal, and is ſtretched out towards the back Part, where the Cartilages of the Noſtrils are connected, that they might be united more firmly.——At the inner Part of the anterior Side, they are pretty thick, eſpecially above, and unequal, that their Conjunction to each other might be ſtronger; and a ſmall Riſing may be there remarked, where they are ſuſtained by the *Septum narium*.——Their poſterior Side, at its upper half, has externally a Depreſſion, where it is overlaped ſome way by the *Oſſa maxillaria*; and the lower half covers theſe ſame Bones: By which Contrivance they neither will eaſily yield to a Preſſure applied to their Fore-part or Sides.— The Bodies of the *Oſſa naſi* are a little convex externally, and concave internally, that they might more ſtrongly reſiſt any Violence and might enlarge the Cavities of the Noſe. —— A ſmall Hole is frequently to be obſerved on their external Surface, into which, two, three or four Holes, which appear internally, terminate, for the Tranſmiſſion of ſmall Veins.

The *naſal Bones* are firm and ſolid, with very few *Cellulæ* or *Cancelli* to be obſerved in them, the thin Subſtance, of which they conſiſt, not requiring any Quantity of Marrow.

They are joined above to the *Os frontis*, by the Middle of the tranſverſe Suture;—behind, to the *Oſſa Maxillaria*, by a ſmall *Harmonia* or Suture of each Side, which might be called *Naſalis lateralis* †;—below, to the Cartilages of the Noſe;—before, to one another by a Suture, which may be named *Naſalis anterior* ‡; —— internally, to the *Septum narium*.

Theſe Bones ſerve to cover and defend the Root of the Noſe.

In an Infant the *naſal Bones* are proportionally ſhorter and leſs thick at their upper Part, than in an Adult, but are otherwiſe complete.

*OSSA UNGUIS* or *LACHRYMALIA* are ſo named, becauſe their Figure and Magnitude is ſomething near that of a Nail of one's Finger, and becauſe the Tears paſs upon them into the Noſe.

Their external Part is compoſed of two hollow ſmooth Surfaces and a middle Ridge.—The poſterior Cavity forms a ſmall Share of the Orbit for the Eye-ball to move on, and the anterior is a deep perpendicular Canal or *foſſa*, larger above than below, containing the lacrymal *Sac* and *Duct*——This *Foſſa* of the Bone appears ſomewhat cribriform, or has a great Number of ſmall Holes through it, that the Filaments from the Membrane which lines it inſinuating themſelves into theſe Holes, might prevent a Separation of the Membrane, and ſecure the Bone in its natural Situation.——The Ridge between theſe two Cavities of the *Os Unguis* is the proper Boundary of the Orbit at its internal *Canthus*.——The internal or poſterior Surface of this Bone conſiſts of a Furrow in the middle of two Convexities.

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† Naſalis obliqua.

‡ Naſalis, naſalis recta.

The Subſtance of the *Os Unguis* is as thin as Paper, and very brittle, which is the Reaſon that thoſe Bones are ſo often wanting in Skeletons.

Each of theſe Bones is joined, above, to the *Os frontis*;—behind, to the *Os planum* of the *Ethmoid* Bone, by Part of the tranſverſe Suture;——before, and below, to the *Os maxillare*, by a ſmall ſemicircular Suture, which the Name of *lacrymalis* would not be improper to:——Internally, the *Oſſa unguis* cover ſome of the *Sinus ethmoidales*; nay, are really continuous with the bony *Lamellæ*, which make up the Sides of theſe Cells; ſo that they are as much Part of the *Ethmoid* Bone as the *Oſſa plana*.

Theſe unguiform Bones compoſe the anterior internal Parts of the Orbits, lodge the lacrymal Sac and Duct, and cover the *Cellulæ ethmoideæ*. From which Situation and tender Subſtance of theſe Bones, we ſee how eaſily a raſh Operator may deſtroy a conſiderable Share of the Organ of Smelling, in performing the Operation of the *Fiſtula lacrymalis*; but that thoſe Bones, when hurt, will caſt off without much Difficulty, and conſequently the Wound will be ſoon cured, unleſs the Patient labours under a general *Cacoethes*, or there is a Prediſpoſition in the Bones to a *Caries*; in which Caſe, a large Train of bad Symptoms follows, or, at beſt, the Cure proves tedious.

Theſe Bones are fully formed in a new born Child.

*OSSA MALARUM* † was the Name given by *Celſus*, as was already remarked, to all the upper Jaw, but is now appropriated to the irregular ſquare prominent Bones, which on each Side form the Cheeks.—— Before, their Surface is convex and ſmooth; backward, it is unequal and concave, for lodging Part of the *Crotaphyte* Muſcles.

The four Angles of each of theſe Bones have been reckoned Proceſſes by ſome.——The poſterior ſuperior one, which is the longeſt and thickeſt, is called the *ſuperior orbitar* Proceſs. ——The ſecond, or anterior ſuperior, which terminates very ſharp, with the two Sides near equally combining to form the Angle, is named the *inferior orbitar* Proceſs.—The anterior inferior which is the ſhorteſt and neareſt to a right Angle, is called *Maxillary*.——The fourth or poſterior inferior Extremity, is pointed with one Side ſtraight, the other ſloping, and is termed *Zygomatic*.—— Between the two orbitar Angles, the concave Arch of a Circle, which makes about a Third of the external Circumference of the Orbit, may be obſerved, from which a fifth Proceſs is extended backwards within the Orbit, to form near one Third of that Cavity; and hence it may be called the internal *orbitar* Proceſs:——About the middle of this, we may remark a conſiderable Notch, which forms Part of the great Slit at the Outſide of the Orbit.——From the lower Edge of the *Oſſa malarum*, between the maxillary and zygomatick Proceſſes, the *Maſſeter* Muſcle takes its Origin; and from the exterior Part of the *Zygomatic* Proceſs the *Muſculus diſtortor oris* riſes; in both which Places a Roughneſs may be remarked on the Surface of the Bone.

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† Jugalia vel Zygomatica, hypopia, ſubocularia.

On the external Surface of the Cheek-bones, one or more ſmall Holes are commonly found, for the Tranſmiſſion of ſmall Nerves or Blood-veſſels from, and ſometimes into the Orbit; ——on the internal Surface, the Holes for the Paſſage of the nutritious Veſſels of theſe Bones are very conſpicuous.——The great Slit at the Outſide of the Orbit, may be conſidered as a Hole common to this Bone, the Sphenoid, Maxillary and Palate Bones.

The Subſtance of theſe Bones is in Proportion to their Bulk, thick, hard and ſolid with ſome *Cancelli*.

The *Oſſa malarum* are joined, by their ſuperior and their internal orbitar Proceſſes to the *Os frontis*, and to the orbitar Proceſſes of the *ſphenoid* Bone, by means of the tranſverſe Suture: ——By their Edges between the internal and inferior orbitar Proceſſes, to the *Oſſa maxillaria*, by means of what may be termed the *internal orbitar* Sutures:——By their Sides, between the maxillary and inferior orbitar Proceſſes, again to the maxillary Bones, by Sutures that may be named *external orbitar*;——by the zygomatick Proceſſes to the *Oſſa temporum*, by means of the *ſuturæ zygomaticæ*.

The Cheek-bones are entire and fully oſſified in all their Parts in Infants.

*OSSA MAXILLARIA SUPERIORA* are the largeſt Bones, and conſtitute the far greater Part of the upper Jaw, which has appropriated the Name of *Maxillaria* to them. Their Figure either conjunctly or ſeparately, is ſo irregular, that Words can ſcarce give an Idea of it.

The *Apophyſes* of each *Os maxillare* may be reckoned ſix.——The *Firſt* is the long Proceſs which riſes from its upper and fore Part, turns ſtill ſmaller, as it runs upwards to make the Side of the Noſe, and from its Situation, one may name it *Naſalis*.——At the Root of this a tranſverſe Ridge may be obſerved within the Noſtrils, which ſupports the Forepart of the upper Edge of the *Os ſpongioſum inferius*.——The *Second* is produced backwards and outwards from the Root of the Naſal Proceſs, and may be called *orbitar*, becauſe it forms the lower Side of that Cavity.——From this proper orbitar Part irregular Riſings are extended outwards where this maxillary Bone is joined to the Cheek-bone.—— The Edge of this orbitar Proceſs, and the Ridge of the naſal which is continued from it, conſtitute a conſiderable Portion of the external Circumference of the Orbit.——Behind the orbitar Proceſs, a large Tuberoſity, or Bulge of the Bone appears, which is eſteemed the third Proceſs.——On the internal Part of this we often meet with a Ridge, almoſt of the ſame Height with that in the naſal Proceſs, which runs tranſverſely, and is covered by a ſimilar Ridge of the *Os palati*, on which the back Part of the upper Edge of the *Os ſpongioſum inferius* reſts;——The convex back Part of this Tuberoſity is rough, as *Albinus (a)* has remarked; for the Origin of Part of the external *Pterygoid* Muſcle, and more internally is ſcabrous, where the Palate and ſphenoid Bones are joined to it.——That ſpongy Protuberance † at the lower Circumference of this Bone, where the Sockets for the Teeth are formed, is reckoned the *Fourth*.——The *Fifth* is all that horizontal Plate, which forms the greater Part of the Baſe of the Noſtrils and Roof of the Mouth: Its upper Surface, which belongs to the Noſtrils, is very ſmooth, but the other below is arched and rough, for the ſtronger Adheſion of the Membrane of the Mouth, which is ſtretched upon it, and in chewing, ſpeaking, *&c.* is liable to be ſeparated.———The *Sixth* riſes like a Spine from the inner Edge of the laſt, and by this Means forms a ſmall Part of the *Septum narium*.

The Depreſſions in each *Os maxillare* are, 1. A Sinuoſity behind the orbitar Proceſs, made by the *temporal* Muſcle. 2. Immediately before the ſame Proceſs, a Pit where the Origin of the *Muſculus elevator labiorum communis*, and *Elevator labii ſuperioris*, with a Branch of the fifth Pair of Nerves, are lodged ſecurely. 3. The hollow Arch of the Palate. 4. The ſemicircular great Notch, or Entry to the lower Part of the Noſtrils, betwixt the Root of the naſal Proceſs and Spine of the palatine *Lamel-*

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(*a*) De oſſib. § 79.

† Φάτνια.

*la.*——Below this, the Fore-part of the Bone is flatened, ſometimes hollowed by the *Muſculus depreſſor labii ſuperioris.* 5. Sockets for the Teeth †. Their Number is uncertain, being ſometimes more, ſometimes fewer, according to the Number of Roots which the Teeth have. 6. The *lachrymal foſſa* in the *naſal Proceſs*, which aſſiſts the *Os unguis* to form a Paſſage for the *lachrymal Duct*;——immediately on the Outſide of this, *Winſlow* (a) remarks a ſmall Depreſſion, from which the inferior or leſſer oblique Muſcle of the Eye has its Origin. 7. The Channel on the upper Part of the great Tuberoſity within the Orbit, which is almoſt a complete Hole; in this a Branch of the ſuperior maxillary Nerve paſſes.——Beſides theſe, the ſuperior Surface of the great Bulge is concave, to receive the under Part of the Eye.——Immediately above the tranſverſe Ridge in the naſal Proceſs, a ſmall Hollow is formed by the *Os ſpongioſum.*——In ſome Subjects, the naſal Proceſs has a ſmall round Pit above the lachrymal Duct, where the little Tendon or Ligament of the orbicular Muſcle of the Eye-lids is inſerted. It is this Tendon, and not the Tendon of the larger oblique Muſcle of the Eye, which there is a Probability of cutting in the Operation of the *Fiſtula lachrymalis.*

The *Foramina* of this Bone are two proper, and two common, which are always to be found, beſides ſeveral others, whoſe Magnitude, Number, *&c.* are uncertain.——The firſt of the proper is the ***external Orbitar***, immediately below the Orbit, by which the infra-orbitar Branch of the ſecond Branch of the fifth Pair of Nerves, and a ſmall Artery come out, after having paſſed in the Channel, at the Bottom of the Orbit, deſcribed *Numb.* 7. of the Depreſſions.—— This Hole is often double, and that when the Nerve has happened to ſplit before it has eſcaped from the Bone.—— The ſecond is the ***Foramen inciſivum***, juſt behind the Fore-teeth, which, at its under Part, is one irregular Hole common to the *Oſſa maxillaria*, when they are joined; but as it aſcends, ſoon divides into two, three, or ſometimes more Holes, ſome of which open into each Noſtril. Through them ſmall Arteries and Veins, and a Twig of the ſecond Branch of the fifth Pair of Nerves paſs, and make a Communication between, or join the lining Coats of the Noſe and Mouth.—— In ſome Subjects, *Steno*'s Duct may be traced ſome Way on the Side of theſe Paſſages next to the Noſe, and ſmall Orifices may be obſerved opening into the Mouth.

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† Βόθρια, ὀλμίσκοι, Alveoli, Foſſulæ, mortariola, Fræna, Locelli, Caveæ, Præſepiola, Loculamenta.

(*a*) Expoſition Anatomique des Os Secs, § 276.

The firſt common Hole is that which appears at the internal poſterior Part of the *Tuberoſity* and of the *Alveoli* of the Teeth, and is formed by a *Foſſa* in this Bone, and a correſponding one in the *Os palati*: Through it a Nerve, which is a Branch of the ſecond Branch of the fifth Pair of Nerves, runs to the Palate.—— The other common Hole is the great Slit in the Outſide of the Orbit deſcribed already, as the ſecond common Hole of the ſphenoid Bone.

On the naſal Proceſs, often Holes may be obſerved for the Paſſage of Veſſels to the Subſtance

ſtance of the Bones, and at the back Part of each Tuberoſity, ſeveral *Foramina* are placed for the Tranſmiſſion of Nerves to the Cavity within: But theſe are uncertain.

All the Body of the *Os maxillare* is hollow, and leaves a large *Sinus*, a-kin to thoſe of the *Os frontis* and *Sphenoides*, which is commonly, but unjuſtly called *Antrum Highmorianum* *, ſince it is ſcarce ever omitted by Anatomiſts, before *Highmore (a)* was ſo particular about it. When the *Os maxillare* is ſingle or ſeparated from all the other Bones of a Skeleton, its *Antrum* appears to have a large Aperture into the Noſtrils; but, in a recent Subject, it is ſo covered at its back Part, by the *Os palati*; in the Middle, by the *Os ſpongioſum inferius*; before, by a ſtrong Membrane, that one, or ſometimes two *Foramina*, ſcarce larger than a Crow-quill, are only left at the upper Part, which, after a ſhort winding Progreſs, open into the *Nares*, between the two *Oſſa ſpongioſa.*—— At the Bottom of this Cavity, we may often obſerve with *Highmore* ſome Protuberances, in which the ſmall Points of the Roots of the Teeth are contained.—— This Cavern, and the Sockets of the Teeth are often divided by the Interpoſition only of a very thin bony Plate, which is liable to be eroded by any acrid Matter collected in the *Antrum*, of which *Highmore* (*b*) gives a remarkable Inſtance. The Symptoms of ſuch a Collection naturally lead us to *Cowper*'s (*c*) Practice of pulling out the Teeth, and piercing through this Plate into the *Antrum*, to procure an Evacuation of the collected Matter, by which, conſiderable Service is frequently done (*a*).

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* Genæ.

(*a*) Diſquiſ. Anat. lib. 3. part. 2. cap. 1.

(*b*) Diſquiſ. Anat. lib. 3. part. 2. cap. 1.

(*c*) Drake's Anthropolog. nov. Book 3. chap. 10.

The *Maxillary Sinuſes* have the ſame Uſes as the *frontal*.

The Subſtance of the *Oſſa maxillaria* is compact and firm, except at the inferior Proceſs, in which the Teeth are lodged, where it is very ſpungy.

The *maxillary* Bones are joined above by the Extremities of their naſal Proceſſes to the *Os frontis*, by Means of the tranſverſe Suture ; —— at the Sides of theſe Proceſſes, to the *Oſſa unguis*, by the *lacrymal* Sutures :—— to the *Oſſa naſi*, by the *lateral naſal* Sutures ;—— by their orbitar Proceſſes, to the *Oſſa malarum*, by Means of the *external orbitar* Sutures ;—— by the internal Sides of the Tuberoſities, to the *Oſſa plana*, by Part of the *ethmoidal* Suture;—— by the back Part of the Tuberoſities, to the *Oſſa palati*, by the *Harmoniæ* or faint *Suturæ palato-maxillares* ;—— by the poſterior Edges of their palatine *Lamellæ*, to the *Oſſa palati* by Means of the *Sutura palatina tranſverſalis* *—— by their naſal *Spines*, to the *Vomer*, by a very ſlight Suture, which might be called *Spinoſa*, or rather by a double *Schindyleſis* ; —— by their Sockets, to the Teeth, by *Gomphoſis* ;—— by the internal Edge of the Palate-*Lamella*, to one another by a Suture, which might be named *Palatina longitudinalis* † ; on the upper and Fore-

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(*a*) Medical Eſſays and Obſerv. Vol. V. Art. 29.

* Arcuata, Palatina tranſverſa poſtica.

† Laquearis, Palataria recta.

Fore-part of which, a Furrow is left for receiving the Cartilage which forms the Partition of the Noſtrils;—— between the Fore-part of the Noſtrils and Mouth to each other by a Suture, which may be named *Myſtacialis*;—— ſometimes they are connected to the *Oſſa ſpongioſa inferiora*, by a plain Concretion or Union of Subſtance.

Thus we ſee theſe two Bones form the greater Part of the Noſe and of the Roof of the Mouth, and a conſiderable Share too of the Orbit. They contain ſixteen Teeth, give Riſe to Muſcles, Tranſmiſſion to Nerves, *&c.* as mentioned in the Deſcription of their ſeveral Parts.

In each of the *Oſſa maxillaria* of a new-born Child, the external orbitar Proceſs is hollow with remarkable *Foramina* in it;—— there are only five Sockets for the Teeth, of which the two poſterior are very large.—— The Palate *Lamella* is cribriform about the Middle.—— The great Tuberoſity is not formed;— Inſtead of the *Antrum*, there is only an oblong Depreſſion at the Side of the Noſtrils.

*OSSA PALATI* are commonly deſcribed as two ſmall ſquare Bones, at the back Part of the Palate or Roof of the Mouth, tho' they are of much greater Extent, being continued up the back Part of the Noſtrils to the Orbit, as *Euſtachius* (*a*) has obſcurely painted, *Vidus Vidius* has hinted (*b*) and delineated (*c*), and *Winſlow* (*d*) has fully demonſtrated. Each Palate-

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(*a*) Tab. 47. Fig. 1, 3, 6, 7, 8.

(*b*) De Anat. lib. 2. cap. 2. explicat. Tab. 6.

(*c*) Tab. 6. Fig. 19.

(*d*) Memoires de l'Acad. des Sciences 1720.

Palate-bone may therefore be divided into four Parts, the Palate-ſquare-bone, the Pterygoid Proceſs, naſal *Lamella*, and orbitar Proceſs.

The Square-bone is unequally concave, for enlarging both the Mouth and Cavity of the Noſe. The upper Part of its internal Edge riſes into a Spine, after the ſame Manner as the Palate-*Lamella* of the *Os maxillare* does, to be joined with the *Vomer*.—Its anterior Edge is unequally ragged, for its firmer Conjunction with the Palate Proceſs of the former Bone.——The internal Edge is thicker than the reſt, and full of unequal prominent Teeth, for its Conjunction with its Fellow of the other Side.——The poſterior Side is ſomewhat in Form of a Creſcent, and thick, for the firmer Connexion of the *Velum pendulum palati*, the internal Point being produced backwards, to afford Origin to the *Muſculus Palato-ſtaphylinus* of *Dionis*, and *Douglas*.—— This Square-bone is well diſtinguiſhed from the *Pterygoid* Proceſs by a perpendicular *Foſſa*, which applied to ſuch another in the *Os maxillare*, forms a Paſſage for the Palatine-Branch of the fifth Pair of Nerves; and by another ſmall Hole behind this, through which a Twig of the ſame Nerve paſſes.

The *Pterygoid* Proceſs is ſomewhat triangular, having a broad Baſe, and ending ſmaller above.—— The back-part of this Proceſs has three *Foſſæ* formed in it; the two lateral receive the Extremities of the two Plates of the Sphenoid Bone, that are commonly compared to a Bat's Wing; the middle *Foſſa* makes up Part of what is commonly called the *Foſſa pterygoidea*: the Fore-ſide of this palatine pterygoid Proceſs is an irregular Concave, where it receives the Back-part of the *Tuberoſitas maxillaris.*—— Frequently ſeveral ſmall Holes may be obſerved in this triangular Proceſs, particularly one near the middle of its Baſe, which a little above communicates with the common and proper Holes of this Bone already taken notice of.

The *naſal Lamella* is extremely thin and brittle, and riſes upwards from the upper Side of the external Edge of the Square-bone, and from the narrow Extremity of the *Pterygoid* Proceſs; where it is ſo weak, and at the ſame time, ſo firmly fixed to the *Os maxillare*, as to be very liable to be broken in ſeparating the Bones; and therefore it is, that Authors have failed in their Deſcriptions of this Bone.—From the Part where this *Lamella* riſes, it runs up broad on the Inſide of the *Tuberoſitas maxillaris*, to form a conſiderable Share of the Sides of the *Antrum Highmorianum*, and to cloſe up the Space between the *ſphenoid* and the great Bulge of the Maxillary Bone, where there would otherwiſe be a large Slit opening into the Noſtrils, as *Albinus* (*a*) has remarked.—— From the middle internal Side of this thin Plate, a croſs Ridge placed on ſuch another of the maxillary Bone is extended; on it, the back Part of the *Os ſpongioſum inferius* reſts:— Along the outſide of this Plate, the perpendicular *Foſſa* made by the Palate Nerve is obſervable.

At the upper Part of this naſal *Lamella*, the Palate Bone divides into two Proceſſes, which I already named *orbitar*;— between which and the Body of the *ſphenoid* Bone, that Hole is formed,

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(a) De Oſſib. ſect. 88.

formed, which I mentioned as the laſt of the Holes common to the *ſphenoid* Bone.——— Sometimes this Hole is wholly formed in the *Os palati*, by a croſs Plate going from the one orbitar Proceſs to the other. A Nerve, Artery and Vein belonging to the Noſtrils paſs here.-- The anterior of the two orbitar Proceſſes is the largeſt, having its anterior Surface contiguous to the back Part of the *Sinus maxillaris*, and its upper Surface appears in the Bottom of the Orbit, behind the back Part of the *Os maxillare* and below the *Os planum*.— Its poſterior Surface is cellular, reſembling much the Appearance of the *Cellulæ Ethmoideæ*, to which it is contiguous; it is placed on the Aperture of the *Sinus ſphenoidalis*, ſo as to leave only a round Hole at its upper Fore-part.——— The other Part of the orbitar Proceſs is joined to the internal Side of the ſuperior poſterior Part of the *Tuberoſitas maxillaris*.

The Palate ſquare Part of this Palate Bone and its pterygoid Proceſs are firm and ſtrong with ſome *Cancelli*; but the naſal Plate and orbitar Proceſſes are very thin and brittle.

The *Oſſa palati* are joined to the *Oſſa maxillaria*, by the Fore-edge of the Palate Square-bone, by Means of the *Sutura palatina tranſverſalis*:— By their thin naſal *Lamellæ*, and Part of their orbitar Proceſſes, to the ſame Bones, by the *Palato-maxillares* Sutures:——— By their *Pterygoid* Proceſſes, to the *Alæ veſpertilionum*, by the *ſphenoid* Suture:——— By the tranſverſe Ridges of the naſal *Lamellæ*, to the *Oſſa ſpongioſa inferiora* by Contact; hence frequently there is an intimate Union of the Subſtance of theſe Bones in old Sculls:—By the orbitar Proceſſes, to the *Oſſa plana* and *Cellulæ ethmoideæ*, by the *Ethmoid* Suture:—To the Body of the *ſphenoid* Bone, by the *ſphenoid* Suture:—By the internal Edge of the Square-bones to one another, by the *Palatina longitudinalis* Suture.

The Palate-bones form Part of the Palate, *Nares*, Orbits and *Foſſæ pterygoideæ*, and cover Part of the *Sinus maxillares*, *ſphenoidales* and *ethmoidei*.

Theſe Bones are very complete in a new-born Infant, the naſal *Lamellæ* being thicker and ſtronger than in Adults; but the orbitar Proceſſes have not the Cells which appear in the Bones of Adults.

When we are acquainted with the Hiſtory of theſe Bones, the Reaſon is evident, why the Eyes are ſo much affected in Ulcers of the Palate, as to be often attended with Blindneſs, which frequently happens in an ill managed *Lues Venerea*; or why, on the other hand, the Palate ſuffers from an *Ægylops*, as in the Inſtance related by *Hoffman* (*a*).

*OSSA TURBINATA*, or *ſpongioſa inferiora*, are ſo called from their pyramidal Figure, ſpungy Texture, without any ſmooth firm outer *Lamella*, and from their Situation at the lower Part of the Noſtrils, towards the Cavity of which they are convex, while on the other Side, which faces the *Antrum maxillare*, they are concave.—From their upper ſtreight Edge, contiguous to the *Oſſa maxillaria*, two ſmall Proceſſes ſtand out: The poſterior, which is like a

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(*a*) Ephemerid. German. Cent. 1. and 2. obſerv. 135.

a Hook, covers ſome of the *Antrum Highmorianum*; the anterior joins with the *Os unguis*, to make up Part of the *Ductus lacrymalis*.—— The lower Edge is a convex Curve, the Middle of which is pendulous, without a Connexion to any Bones; but the back Part, which ends in a very acute Angle with the upper Edge, is ſupported by the tranſverſe Ridge of the naſal *Lamella oſſis palati*; and the anterior Extremity, which is broad and ragged, reſts on the tranſverſe Ridge of the *Os maxillare*, at the In-ſide of the Root of the naſal Proceſs.

Beſide the two ſpongy Bones mentioned as Part of the *ethmoid* Bone, and theſe juſt now deſcribed, *Cowper* (*a*) mentions two others, one in each Noſtril, that are ſometimes found ſituated lower than any of them, and ſeem to be a Production of the Sides of the maxillary *Sinus* turned downwards. When this third Sort of ſpongy Bones is found, the middle one of the three in each Noſtril is the largeſt, and the loweſt is the ſmalleſt.—— *Santorini* (*b*) remarks, that there are often ſeveral other ſmall Bones ſtanding out into the Noſtrils, that from their Shape might alſo deſerve the Name of *Turbinata*, but are uncertain in their Bulk, Situation and Number.

The Names of theſe Bones ſufficiently declare their Subſtance.

They are joined to the *Oſſa maxillaria*, *palati* and *unguis* in old Subjects, by a firm Union of Subſtance; and as this happens alſo frequently in People of no great Age, *Santorini*

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(*a*) Drake's Anthropolog. Book 3. Chap. 10.
(*b*) Obſervat. Anatomic. cap. 4. ſect. 9.

*torini* (*a*) is of Opinion that they ſhould be eſteemed Part of the Palate-bones.

Their Uſe is, to ſtraiten the Noſtrils, to afford a larger Surface for extending the Organ of Smelling, to cover Part of the *Antra maxillaria*, and to aſſiſt in forming the Under-part of the lacrymal Ducts, the Orifices of which into the Noſe are concealed by theſe Bones.

The *Oſſa turbinata* are complete even in a new-born Infant.

*VOMER*, or Bone reſembling a Ploughſhare, is the thirteenth of the upper Jaw, without a Fellow, forming the lower and back Parts of the *Septum narium*, and firſt deſcribed as a diſtinct Bone by *Columbus* (*b*) and *Fallopius* (*c*).

The Figure of this Bone is an irregular Rhomboid.—— The poſterior Side appears in an oblique Direction at the Back-part of the Noſtrils.—— The upper Side is firmly united to the Baſe of the *ſphenoid* Bone, and to the naſal *Lamella* of the *Ethmoid*; and, when it can be got ſeparated, is hollow, for receiving the *Proceſſus azygos* of the *ſphenoid*.—— The anterior Side has a long Furrow in it, where the middle Cartilage of the Noſe enters.—— The lower Side is firmly united to the naſal Spines of the maxillary and Palate-bones.——Theſe Sides of this Bone are much thicker than its Middle, which is as thin as the fineſt Paper; by which, and the firm Union or Connexion this Bone has above and below, it can very ſeldom be ſeparated entire; which I ſuppoſe is the Reaſon why Authors have

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(*a*) Obſervat. Anat. cap. 4. ſect. 7.
(*b*) De re Anatom. lib. 1. cap. 8.
(*c*) Obſervat. Anatom.

have generally failed in the Deſcription of ſome of the Parts of this Bone: But in a Child, the Mechaniſm much more evidently diſcovers itſelf; wherefore I ſhall examine more particularly all its Parts, as they are to be found in ſuch a Subject.

Its Situation is not always perpendicular, but often inclined, as well as the naſal *Lamella ethmoidea*, to one Side.

Its upper Edge (under which I comprehended the ſuperior and anterior Sides in the former Deſcription) is a convex Arch behind, then becomes ſtreight, as it runs down and forwards; and is compoſed of two Plates, the Extremities of which have a great Number of ſmall Proceſſes, diſpoſed ſomewhat like the Teeth of a Saw, but more irregular, and ſeveral of them are reflected back. Between theſe Plates a deep *Foſſa* is left, which, ſo far as the Top of the Curvature, is wide, and has ſtrong Sides for receiving the *Proceſſus azygos* of the *ſphenoid* Bone. Beyond the Arch forwards, the *Foſſa* is narrower and ſhallower gradually to the Point of the Bone, receiving for ſome way the naſal *Lamella ethmoidea*, which is ſo cloſely united to the *Vomer* by the little Proceſſes piercing into its Subſtance, as to prevent any Separation, on which Account *Lieutand* (*a*) eſteems it to be a Part of the Ethmoid Bone; and beyond that, the middle Cartilage of the Noſe fills up what remains of the *Foſſa*.——— The poſterior Edge of the *Vomer*, which appears above the back Part of the Palate-bones, is broader above; but as it deſcends forwards,

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(*a*) Eſſais Anatomiques 1. ſect. l'Os ethmoide.

becomes thinner, though it is ſtill ſolid and firm.— The lower Edge of this Bone, which reſts on the naſal Spine of the *Oſſa palati* and *Maxillaria*, has a little Furrow on each Side of a ſmall middle Ridge, anſwering to the Spines of the Bones of different Sides, and the Interſtice between them. This Edge, and the upper one meet in the pointed anterior End of this Bone.

The Body of the *Vomer* has a ſmooth Surface, and ſolid, but thin Subſtance; and towards its Sides, where it is thickeſt, ſome *Cancelli* may be obſerved when the Bone is broken.

It is joined above to the *ſphenoid* and *ethmoid* Bones, and to the middle Cartilage of the Noſe, by *Schindyleſis*;—— below, to the maxillary and Palate-bones, by a double ſort of *Schindyleſis*.

The *Vomer* divides the Noſtrils, enlarges the Organ of Smelling, by allowing Place for expanding the *Membrana narium* on its Sides, and ſuſtains the Palate *Lamellæ* of the *Oſſa maxillaria* and *palati*, which otherwiſe might be in Hazard of being preſſed into the Noſtrils, while the *Vomer* is ſecured from ſhuffling to one Side or other by the double *Schindyleſis*, by which it is joined to the Bones above and below.

Theſe then are all the Bones which compoſe the upper Jaw, except the Teeth, which are ſo much a-kin to thoſe of the *Maxilla inferior*, that I chuſe to make one Deſcription ſerve for both, in which, what Difference is obſervable in either of them ſhall be remarked, and that after the ſecond Part of the Face, the lower

Jaw, is demonſtrated, becauſe the Structure of the Teeth cannot be well underſtood, until the Caſe in which they are ſet is explained.

*MAXILLA INFERIOR* ‡, the lower Jaw, conſiſts only of one moveable Bone, and ſixteen Teeth incaſed into it.

This Bone which is ſomewhat of the Figure of the *Greek* Letter *υ*, is ſituated at the lower Part of the Face, ſo as its convex middle Part is forwards, and its Legs are ſtretched back. It is commonly divided into the Chin, Sides and Proceſſes. The *Chin* is the anterior middle Part, the Extent of which to each Side is marked on the external Surface by the Holes obſervable there, and internally by the Beginning of an oblique Ridge.——Beyond theſe the *Sides* appear, and are continued till the Bone, by bending upwards, begins to form the Proceſſes.

On the Fore-part of the *Chin*, a tranſverſe Ridge appears in the Middle, where the two Pieces, into which this *Jaw-bone* is divided in Children, are united. On each Side of this Ridge the *Muſculi quadrati*, or *Depreſſores labii inferioris*, and the *Elevatores labii inferioris Cowperi*, depreſs the Bone: And below theſe Prints, a ſmall Riſing may be obſerved, where the *Depreſſores* commence.—— On the poſterior Surface of the Chin, near the Line that marks the former Diviſion in Children, ſometimes three, always two ſmall Protuberances appear. To the uppermoſt, when it is ſeen, the *Frænum* of the Tongue is connected. From the Middle, the *Muſculi geniogloſſi* riſe, and from the loweſt the

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‡ Γένος, *σιάγων*, Mandibula, facies.

*Geniohyoidei* have their Origin. Below the laſt, we ſee two rough Sinuoſities formed by the *digaſtrick* Muſcles.

At the inferior and anterior external Part of each Side of the lower Jaw, a ſmall Eminence may be obſerved, where the *Depreſſor labiorum communis* riſes: Near the upper Edge a Ridge runs length-ways, to which the lower Side of the *Muſculus Buccinator* is connected.—— Internally, towards the upper Edge of each Side, another Ridge appears, from which the *Mylohyoidei* have their Origin, and to which the internal Membrane of the Gums adheres.

On the upper Edge of both Chin and Sides are a great many deep Pits or Sockets, for receiving the Roots of the Teeth. The Number and Magnitude of theſe Sockets are various, becauſe of the different Number, as well of the Teeth themſelves, as of their Roots, in different People. Theſe Sockets in both Jaws, when freed from the Teeth by any means, are ſome Time after filled up with an oſſeous Network, which at laſt becomes entirely ſolid, and as ſmooth as any other Part of the Bone; ſo that in a great many old Jaws one cannot obſerve any Veſtige of the Sockets: But then the Jaw becomes leſs, and much narrower, as *Veſalius* (*a*) obſerves; and ſometimes, when new Teeth are protruded, new Sockets, taken notice of by *Fallopius* (*b*), are again formed.—— The lower Edge of the Chin and Sides is ſmooth and equal, and is commonly called the *Baſe* of the lower Jaw: The Extremities of the Baſe are

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(*a*) Anat. Lib. 1. Cap. 10.

(*b*) Obſerv. Anat.

are termed the *Angles*; the external Surface of each of which has ſeveral Inequalities upon it, where the *Maſſeter* Muſcle is inſerted; as the internal Surface alſo has, where the *Pterygoideus internus* is fixed.

The Proceſſes are two on each Side.— The anterior ſharp thin *Apophyſes* are named *Coronoid*. Round theſe the *crotaphite* Muſcles are inſerted.—The poſterior Proceſſes called *Condyles* † terminate in an oblong ſmooth Head, ſupported by a *Cervix*. The Heads, whoſe greateſt Length is tranſverſe, and whoſe Convexity is turned forwards, are tipp'd with a Cartilage, as the articulated Parts of all other moved Bones are.— The Roots and Neck of theſe *Condyloid* Proceſſes are a little hollow and rough, where the *Pterygoidei externi* Muſcles are inſerted.

The *Foramina* of the lower Jaw are two on each Side; one at the Root of the Proceſſes internally, where a large Branch of the third Branch of the fifth Pair of Nerves and an Artery enter, and a Vein returns. A ſmall ſharp Proceſs frequently jutts out backwards from the anterior Edge of this Hole, and from its lower Side, either a ſmall ſuperficial Canal deſcends, or a Furrow is to be remarked, where a ſmall Branch of the Nerve is lodged, in its Way to the *Mylo-hyoideus* Muſcle and ſublingual Gland, as *Palfyn* (*a*) has juſtly obſerved.—— The other Hole is external, at the Confines of the Chin, where theſe Veſſels come out.—— The Canal betwixt theſe two Holes is formed in the Middle of the Subſtance of the

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† Articulatorii.

(*a*) Anat. Chirurg. traité 5. chap. 6.

Bone, and is pierced by a great Number of ſmall Holes by which the Nerves and Blood-veſſels of the *Cancelli* and Teeth paſs. The Extremity of this Channel is continued a little further than the external Hole at the Chin.

The Surface of the lower Jaw is hard and firm, except at the ſpungy Sockets, where however it is ſtronger than the upper Jaw. Its internal Subſtance is cellular; but at the Baſe, where it is moſt expoſed to Injuries, the Sides of it are thick and ſolid, both which Properties increaſe towards the Middle of the Chin, where the *Cancelli* of both Sides communicate.

The lower Jaw generally receives into its Sockets the Roots of ſixteen Teeth, by *Gomphoſis*; and its *condyloid* Proceſſes, covered with Cartilage, are articulated with the *Oſſa temporum*, by what I called the third Species of *Ginglimus*, but in a Manner that is not commonly deſcribed right: For, as was already mentioned in the Deſcription of the temporal Bones, not only the Cavity between the *zygomatic*, *auditory* and *vaginal* Proceſſes, but alſo the adjoining Tubercle at the Root of the *zygomatic* Proceſs of each *Os temporum* is covered with a ſmooth Cartilage, to facilitate the Motion of the *Condyles*, either in the Cavities, or on the Tubercles, as different Occaſions require. 'Tis further obſervable, that an intermediate moveable Cartilage is here placed, which being thin in the Middle, and thick at the Edges, is concave on both Sides; and is ſo firmly connected by Ligaments to each *Condyle*, as to follow the Motions of the *Condyle*; and is ſo looſely faſtned to the *Os temporum*, as readily to change its Situation from the Cavity to the Tubercle, and to return again; while the common Ligament of the Articulation affords Space enough for ſuch a Change of Place.

From which View of theſe Articulations we may eaſily conceive how the ſeveral Motions of the lower Jaw are performed: For while the Teeth of both Jaws coincide, the *Condyles* ſecurely play in the Cavities; but when the lower Teeth are advanced forward, beyond the Range of the upper, the *Maxilla* reſts on the Tubercles, by which the neceſſary Advancement of this Bone is allowed; and notwithſtanding the Change of Place, a firm Axis of Motion is ſtill afforded: Tho' at the ſame Time it muſt be granted, that in this ſtraining Poſition we cannot open our Mouths, unleſs by a convulſive Action of the Muſcles, and then not without ſome Danger of a Luxation of the *Condyles*, which often happens to old People, or Children in yawning. Whence the common Practice of Nurſes in reſtraining the Jaws of Children from opening too wide in that convulſive Motion, is far from unreaſonable. Theſe Cartilages alſo ſerve to render the Articulations looſe enough for performing the lateral Motions; and therefore, by a quick Succeſſion of the Motions forwards, to one Side, backwards, and then to the other Side, the *Condyles* may be moved in a Circle, which is of good Uſe in chewing *(a)*.

Here a general Remark may be made, That where-ever ſuch moveable Cartilages are found, either the articulated Bones are of ſuch a Figure, or

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(*a*) Vid. *Edinburgh* Medical Eſſays, and Obſerv. Vol. I. Art. 11. for a more full Account of this Articulation.

or ſo joined and fixed by their Ligaments, that little Motion would be allowed without ſuch Cartilages; or elſe ſome Motions are neceſſary to the right Uſe of the Member, which the Form of the Articulation would not otherwiſe admit of. This will more fully appear after the other Joints with ſuch Cartilages are deſcribed.

In a Child born to the full Time the lower Jaw is compoſed of two Bones, connected by a thin Cartilage in the Middle of the Chin which gradually oſſifies, and the two Bones intimately unite.—In each of theſe Bones there are five Sockets for Teeth, as in the upper Jaw.

After I have thus deſcribed the Incaſement of the Teeth, the Inſertion of ſo many Muſcles of the Tongue and of the *Os hyoides*, the Connexion of the Membrane of the Tongue to the maxillary Bone, and the Motions of this Bone, 'tis eaſy to ſee that the lower Jaw muſt be a principal Inſtrument in Manducation, Deglutition and Speech.

The *TEETH* are the hard white Bodies placed in the Sockets of both Jaws. Their Number is generally ſixteen above, and as many below, tho' ſome People have more, others have fewer.

The broad thick Part of the Teeth, which appears without the Socket, is the *Baſe* or Body †.—The ſmaller Proceſſes ſunk into the *Maxillæ*, are the *Roots* or *Fangs*.—At the Place where the Baſe ends, and the Roots begin, there is generally a ſmall circular Depreſſion, which ſome call the *Neck* or *Collar*.

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† Corona.

Without the Gums the Teeth are covered with no Membrane, and they are ſaid to have no proper *Perioſteum* within the Sockets; but that is ſupplied by the reflected Membrane of the Gums; which after a good Injection, may be evidently ſeen in a young Subject, even when it is dried; and as *Cowper (a)* has very well remarked, it may be diſcovered in any Tooth recently pulled, by macerating it in Water. The Adheſion of this Membrane to theſe Roots is ſtrengthned by the ſmall Furrows obſervable on them.

Each Tooth is compoſed of two Subſtances, its *Cortex*, and an internal bony Subſtance. The *Cortex* has no Cavity or ſpongy Subſtance for Marrow, and is ſo ſolid and hard, that Saws or Files can with Difficulty make Impreſſion on it. It is thickeſt upon the Baſe, and gradually, as the Roots turn ſmaller, becomes thinner, but not proportionally to the Difference of the Size of the Baſe and Roots.——The Fibres of this Enamel are all perpendicular to the internal Subſtance, and are ſtreight on the Baſe, but at the Sides are arched with the convex Part towards the Roots; which makes the Teeth reſiſt any Violence from the Compreſſion of a hard Body between the Jaws, with leſs Danger of breaking theſe Fibres, than if they had been ſituated tranſverſely. The ſpongy Sockets in which the Teeth are placed, likewiſe ſerve better to prevent ſuch an Injury, than a more ſolid Baſe would have done.——Notwithſtanding the great Hardneſs of this *Cortex*, it is waſted by Manducation. Hence the ſharp

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(*a*) Anatomy Explicat, tab. 92. fig. 7. lit. E.

Edges of ſome Teeth are blunted and made broad, while the rough Surfaces of others are made ſmooth and flat.

The internal Subſtance of the Teeth is Bone, with its Fibres running ſtreight according to the Length of the Teeth; which, when expoſed to the Air by the breaking or falling off of the hard *Cortex*, muſt ſoon corrupt or be deſtroyed, as is the Nature of all Bones: And thence carious Teeth are often all hollow within, when a very ſmall Hole appears only externally.

The bony Subſtance of the Teeth has a Channel formed in its Middle, wherein their Nerves and Blood-veſſels are lodged; which they certainly need, being conſtantly waſted by the Attrition they are ſubjected to in Manducation, and for their further Growth after they firſt appear. And it is certain, as *Ingraſſias (a)* juſtly affirms, that they are capable of becoming longer and broader in Adults; which does remarkably happen, when any Tooth of a young Perſon is taken out: For then the oppoſite one becomes longer, and theſe on each Side of the empty Socket turn broader; ſo that when the Jaws are brought together, it is ſcarce obſervable where the Tooth is wanting.

The Veſſels are eaſily traced as long as they are in the large Channel, but can ſcarce be obſerved in their Diſtribution from that to the Subſtance of the Teeth of Adults: *Ruſych (b)* however affirms that he could, after Injection, trace the

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(*a*) De Tumor. cap. 1.
(*b*) Theſaur. 10. num. 27.

the Arteries into the hardeſt Part of the Teeth. And *Lewenhoek (b)* ſuſpected the Fibres of the *Cortex* to be Veſſels. In Children I have frequently injected the Veſſels of the Teeth as far as their Baſe: And in ſuch as are not entirely oſſified, one can with a lucky Injection fill ſo many Veſſels, as to make the Inſide of the cortical Part appear perfectly red.——This plentiful Supply of Veſſels muſt expoſe the Teeth to the ſame Diſorders that attack other vaſcular Parts; and ſuch Teeth as have the greateſt Number of Veſſels, muſt have the moſt numerous Chances of being ſeized with theſe Diſeaſes.

Every Root of each Tooth has ſuch a diſtinct Canal with Veſſels and Nerves in it. Theſe Canals in the Teeth with more than one Root, come nearer each other, as they approach the Baſe of the Tooth, and at laſt are only ſeparated by very thin Plates, which being generally incomplete, allow a Communication of all the Canals, and frequently one common Cavity only appears within the Baſe, in which a pulpy Subſtance compoſed of Nerves and Veſſels is lodged. The Condition therefore of the Nerves here, bears a ſtrong Analogy to that of the cutaneous Nerves which ſerve for the Senſation of Touching. And ſince the *Cuticula* can be rubbed off or cut without Pain, allows the Nerves to be affected by Heat or Cold, and tranſmitts acid or auſtere Liquors, that blunt the Touch conſiderably, and give an uneaſy Senſation at the ſame time; and that ſeveral Subſtances, notwithſtanding this

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(*a*) Arcan. Natur. Continuat. Epiſt. p. 3.

this interpoſed Membrane, do create a painful *Tremor*, by their numerous or frequently repeated Impulſes. When, I ſay, all this is conſidered, the analogous *Phænomena* in the Teeth, which the Ancients diſputed ſo much about, will appear to be of no difficult Solution.

The Entry of the Channels for theſe Veſſels, is a ſmall Hole, to be ſeen a little to a Side of the extreme Point of each Root; ſometimes, eſpecially in old People, this Hole is entirely cloſed up, and conſequently the Nerves and Blood-veſſels are deſtroyed, as *M. de la Hire* the younger *(a)* has remarked.

The Teeth are ſeen for a conſiderable Time in form of *Mucus* contained in a Membrane; afterwards a thin cortical Plate, and ſome few oſſeous Layers appear within the Membrane, with a large Cavity filled with *Mucus* in the Middle, and gradually this exterior Shell turns thicker, the Cavity decreaſes, the Quantity of *Mucus* is leſſened, and this Induration proceeds till all the Body is formed, from which the Roots are afterwards produced.

In young Subjects, different *Stamina* or Rudiments of Teeth are to be obſerved, within the ſame Socket, theſe next the Edge of the Gums hinder ordinarily the deeper ſeated ones from making their Way out, while theſe prevent the former from ſending out Roots, or from entring deep into the bony Sockets of the Jaws, by which they come to be leſs fixed.

Children ſeldom have Teeth appearing without their Gums, when new born, but when they are two Years old or little more, have twenty, and their Number does not increaſe, till about ſeven Years of Age, when the Teeth that firſt made their Way through the Gums, are thruſt out by others that have been formed deeper in the Jaw, and ſome more of the Teeth begin to diſcover themſelves farther back in the Mouth. About fourteen Years of Age, ſome more of the firſt Crop are ſhed, and the Number is increaſed.—— This Shedding of the Teeth is of good Uſe; for if the firſt had remained, they would have ſtood at a great Diſtance one from another; becauſe the Teeth are too hard in their outer Cruſt, to encreaſe ſo faſt as the Jaws do. Whereas both the ſecond Layer, and the Teeth that come out late, meeting, while they are ſoft, with a conſiderable Reſiſtance to their Growth in Length from thoſe ſituated upon them, will neceſſarily come out broad, and fit to make that cloſe Guard to the Mouth †, which they now form.

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(a) Hiſtoire de l'Acad. des Sciences, 1699.

The Teeth are joined to the Sockets by *Gomphoſis*, but are principally faſtned there by the Gums, as is evident by their falling out when the Gums are any Way deſtroyed, or made too ſpongy, as in the *Scurvy* or *Salivations*; whence ſeveral Authors claſs this Articulation with the *Syſſarcoſis*.

The Uſes of the Teeth are to maſticate our Aliment, and to aſſiſt us in the Pronunciation of ſeveral Letters.

Though the Teeth ſo far agree in their Structure, yet becauſe of ſome Particulars wherein they differ, they are generally divided into

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† Φραγμὸς.

three Claſſes, *viz. Inciſores*, *Canini* and *Molares.*

The *Inciſores* * are the four Fore-teeth in each Jaw, receiving their Name from their Office of cutting our Aliment, for which they are excellently adapted, being each formed into a ſharp cutting Edge at their *Baſe*, by the Extremity of their anterior Side turning inwards, while the poſterior Surface is ſloped down and hollowed †; ſo that they have the Form of Wedges; and therefore their Power of acting muſt be conſiderably increaſed, as is demonſtrable in Mechanicks.—— Seeing in the Action of the *Inciſores*, a perpendicular Compreſſion is only neceſſary, without any lateral Motion, they are not ſo firmly fixed in their Sockets as the other Teeth are, having neither ſo many nor ſo long Roots, but are only poſſeſſed of one ſhort Stump.

The Inciſores of the upper Jaw, eſpecially the two middle ones ‡ are broader and longer generally than thoſe of the under Jaw.

In a new-born Infant, the outer Shell of the Body of theſe Teeth is only hardned.

*Canini* *, from the Reſemblance to Dogs Tusks, are one on each Side of the *Inciſores* in each Jaw.—— The two in the upper-Jaw are called *Eye-teeth*, from the Communication of Nerves which is ſaid to be betwixt them and the Eyes.—— The two in the lower Jaw are named angular or Wike-teeth, becauſe they ſupport the Angles of the Mouth.

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* Γελασῖνοι, τομίκοι, διχαςῆρες, κτένες, τομεῖς; ϖροσθιοι, ὀξεῖς, Riſorii, quaterii, primi, primores, anteriores, acuti.

† Ὀλμίσκος.

‡ Duales.

* Κυνόδοντες, Riſorii, fractorii, collaterales, columellares.

The *Baſes* of the *Canini* are broader than thoſe of the *Inciſores*, though they are alſo ſloped on the interior Side. They are longer than any other Teeth, and ſtronger than thoſe of the former Claſs. The *Canini* of the upper Jaw are the largeſt and longeſt, and have the Extremity of their Roots crooked, and ſo are more firmly ſecured in their Sockets. Hence it is evident how well theſe are adapted, for breaking and bruiſing ſolid Bodies, this being a Sort of mixed Action betwixt cutting and grinding, the proper Offices of the other two *Claſſes*.

The *Canini* of a Child are formed much in the ſame Manner as the *Inciſores* are.

The *Dentes molares* or *Grinders* †, which have got their Name becauſe they grind our Food, are generally five in each Side of each Jaw, in all twenty. They are the broadeſt Teeth of any, with both Sides equally raiſed, or nearly ſo, but are unequal and ſcabrous at their Baſes, to be better fitted for their Office. The Body of the firſt is generally the leaſt, and comes neareſt to the *Canini* in its Shape. The third and fourth are the largeſt, and the fifth is next in ſize to them.

Some of the *Molares* have only one Root, others have two, three, four or five, to prevent their looſening by the lateral Preſſure which they ſuffer; and in the upper Jaw, their Roots are commonly more numerous, and more ſeparated than in the lower, becauſe the ſuperior Teeth are more liable to fall out, by their Situation and the Structure of their Sockets, as *Galen* (*a*) has obſerved. The Number however of the Roots of each of them is very uncertain, ſometimes they are more, ſometimes fewer, frequently ſeveral Roots are joined together, at other times they are all diſtinct. The Diſpoſition of ſuch as are diſtinct is alſo various; for in ſome the Extremities of the Roots go out ſtreight, in others they ſeparate, and in others again they are crooked inwards. In general we obſerve, that the farther back in the Mouth theſe Teeth are ſituated, the Number of Roots is greater; and when they are united, we can ſtill diſtinguiſh them, by remarking the Number of ſmall Holes at their Points, which determine the Number of Roots the Tooth ought to be reckoned to have.

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† Μυλίται, γόμφοι, μύλοι, πλατεῖς, φραστῆρες, maxillares, menſales, clavales, Bucearum.

The cortical Subſtance at the Baſe of the *Grinders* is thinner than in any other Teeth.

The two Teeth that are placed fartheſt back in each Jaw, are diſtinguiſhed by the particular Name of *Dentes ſapientiæ* †, becauſe they commonly cut the Gums about the twenty firſt Year of our Age, when the Laws allow People to be *ſui juris*, and capable to manage their own Affairs. Their Bodies are ſmaller, and their Roots are not generally ſo numerous as in the third and fourth.

At the time of Birth, only two *Dentes molares* in each Jaw have begun to oſſify, and that at little more than the Baſe, which has ſeveral ſharp Points ſtanding out from it.

From

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(*a*) De Oſſib. cap. 5.

† Σωφρονιστῆρες, κραντῆρες, ὀψίγονοι. Sensûs, intellectûs, ſerotini, ætatem complentes, genuini, moderatores.

From what has been ſaid, the Anſwers to the following Queries may eaſily be given.

Why in Children do the *Dentes inciſores* firſt cut the Gums, the *Canini* next, and *Molares* laſt?

Why do Children ſhed their Teeth at a certain Age?

Wherefore have theſe *temporaneous* Teeth generally no Roots, or very ſmall ones?

Why have theſe firſt Teeth ſometimes Roots?

Why do theſe Roots frequently come thro' the Gums?

Whence come *Butter* or *Buck* Teeth?

How do theſe Teeth ſometimes go into the natural Row with the others, after pulling a rotten Tooth near them?

How have ſome People got two Rows of Teeth in one or both Jaws?

Why do the Teeth of old People looſen, and then drop out entire?

Whence ariſe the new Setts of Teeth which ſeveral old People obtain?

Why are not the Gums of toothleſs old People torn by the hard Sockets in chewing?

Why are the Teeth inſenſible when ſlightly filed or raſped?

How come they to be ſenſible of Heat or Cold, to be ſet on Edge by Acids, or to give ſuch an uneaſy Senſation, when gritty or ſandy Subſtances are rubbed between them?

What is the Reaſon of ſome Perſons dying convulſed, upon raſping or filing down an overgrown Tooth?

What Parts are affected in the Tooth-ach?

Why are the *Dentes molares* moſt ſubject to that Diſeaſe?

How do the Teeth break and moulder away without any Pain in ſome People, and not in others?

Whence proceeds the violent obſtinate *Hæmorrhagy* which ſometimes attends the drawing of Teeth?

Why is it more difficult and dangerous to draw the Eye-teeth than any other?

What makes it impoſſible frequently to draw *Grinders* without bringing away Part of the Jaw-bone with them, or breaking the Fangs?

Why have ſmall Worms been ſometimes found in carious Teeth?

According to the Diviſion made of the Skeleton, we ſhould now proceed to the Deſcription of the Trunk of the Body: but muſt firſt conſider a Bone, which cannot well be ſaid to belong to either the Head or the Trunk; nor is it immediately joined to any other, and therefore is very ſeldom preſerved with Skeletons; however it is generally deſcribed by Authors after the Bones of the Face. In Obedience therefore to the prevailing Method, I ſhall next examine the Structure of

The *OS HYOIDES* †, which is ſituated horizontally between the Root of the Tongue and the *Larynx*. It is properly enough named *Hyoides*, from the Reſemblance it bears to the *Greek* Letter *υ*, and may, for a clearer Demonſtration of its Structure, be diſtinguiſhed into its *Body*, *Cornua* and *Appendices*.

The Body is the middle broad Part, convex before, and hollow behind. The convex anterior Surface is divided into two, by a ſharp Ridge, into the Middle of which the *Mylo-hyoidei*, and into the Sides the *Stylo-hyoidei* Muſcles are inſerted.—— The Part of the anterior Surface above this Ridge is horizontal, but pitted in the Middle by the Inſertion of the two *Genio-hyoidei* Muſcles, and a little hollowed more laterally by the *Baſio-gloſſi*.—— The lower Part of this Surface is convex, but a little flatned in the middle by the *Sterno-hyoidei*, and pitted more externally by the *Coraco-hyoidei*.—— The poſterior Surface of this Body of the *Os hyoides* is concave, but ſituated obliquely, ſo as to face backwards and downwards: Into this Concavity the *Thyroid* Cartilage is received, when the *Larynx* and this Bone are pulled nearer by the Action of the *Sterno-hyoidei* and *Hyo-thyroidei*; and to its upper Edge the ligamentous Membrane of the *Epiglottis* and Tongue is fixed.

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† Hypſyloides, Lambdoides, *παραστάτη*, *φαρυγγίτρεον*, Os gutturis, os linguæ, os morſûs Adami, aſſeſſor, os laude, Bicorne.

The *Cornua* † of the *Os hyoides* are ſtretched backwards from each Side of its Body, where often a ſmall Furrow points out the former Separation; for in younger Subjects the Body and *Cornua* are not one continued Subſtance, as they come afterwards to be in Adults.—— Theſe *Cornua* are not alway's ſtreight, nor of equal Length; their two plain Surfaces ſtand obliquely, ſloping from above outwards and downwards.— Into the anterior the *Cerato-gloſſus* is inſerted above, and the *Thyro-hyoideus* Muſcle below; and to the poſterior Surface the ligamentous Membrane of the Tongue and *Larynx* adheres.—— Each of the *Cornua* becomes gradually ſmaller towards its Extremity, where generally a ſmall rounded Tubercle may be obſerved, from which a moveable Cartilage ſtands out, which is connected to the ſuperior Proceſs of the *Cartilago Thyroidea.*

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† Crura, Latera inferiora.

Where the Body of the *Os hyoides* joins on each Side with its *Cornua*, a ſmall Styli-form Proceſs called *Appendix* ‡ riſes upwards and backwards into which the *Muſculi Stylo-hyoidei alteri*, and Part of the *Hyo-gloſſi* Muſcles are fixed. From them a Ligament is extended to the *Styloid* Proceſſes of the temporal Bones, to keep the *Os hyoides* from being drawn too much forwards or downwards. The part of this Ligament next to theſe Proceſſes ſometimes forms into ſeveral Cartilages, which afterwards oſſify in old People. *Ruyſch* (*a*) ſays that he has ſeen this Oſſification continued as far up as the Styloid Proceſſes, which were therefore joined to the *Os hyoides* by *Anchyloſis.*

The Subſtance of the *Os hyoides* is cellular, but covered with a firm external Plate, which is of ſufficient Strength to bear the Actions of ſo many Muſcles as are inſerted into it.

It is not articulated with any Bone of the Body, except by means of the Muſcles and Ligaments mentioned.

The Uſe of the *Os hyoides*, is to ſerve as a ſolid Lever for the Muſcles to act with, in raiſing or depreſſing the Tongue and *Larynx*, or in enlarging and diminiſhing the Capacity of the *Fauces.*

At the Birth, this Bone is in a cartilaginous

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‡ Crura ſuperiora, Latera ſuperiora, Oſſa graniformia.

(*a*) Adverſ. Anat. Dec. 3. § 9.

State, excepting a ſmall Point of Bone in the Middle of its Body, and in each of the *Cornua.* ——The *Appendices* frequently remain cartilaginous many Years.

## *Of the Trunk.*

THE *TRUNK* conſiſts of the *Spine*, *Pelvis* and *Thorax*.

The *SPINE* † is that long Pile of Bones reaching from the *Condyloid* Proceſſes of the *Occiput*, to the Extremity of the Rump. It ſomewhat reſembles two unequal Pyramids, whoſe Baſes are common, or joined together. The Spine is not however ſtreight, but has four or five remarkable crooked Turns; for in deſcending from its upper Part, it is made to advance forwards by the Force of the Muſcles that pull the Head and firſt *Vertebræ* back, which is greater than the contracting Power of the Flexors, and thereby it ſupports the *OEſophagus*, Veſſels of the Head, *&c.* Its Middle gives Way backwards to the Heart and Lungs; then it is again bended forwards, to ſupport the *Viſcera* of the *Abdomen*; it afterwards turns backwards for the Enlargement of the *Pelvis*; and, laſtly, it is reflected forwards for ſuſtaining the laſt great Gut. We ſhould however obſerve, that notwithſtanding this crooked Figure of the Spine, it is ſo contrived, that the Center of Gravity of all that Part of it which ſuſtains any conſiderable Weight, falls on the Middle of the common Baſe,

The *Spine* is commonly divided into *true* and

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† Ῥάχις, νῶτον, ἄκανθα, ἱερὰ σῦριγξ, σωλὴν, Tergum, Hominis Carina.

*falſe Vertebræ*, the former conſtituting the ſuperior long Pyramid with its Baſe below, while the *falſe Vertebræ* make the inferior ſhorter Pyramid, whoſe Baſe is above.

The *TRUE VERTEBRÆ* † are the twenty four ſuperior Bones of the *Spine*, on which the ſeveral Motions of the Trunk of our Bodies are performed, from which Uſe they have juſtly got their Name.

Each of theſe *Vertebræ* is compoſed of its Body and Proceſſes.

The Body is the thick ſpongy Fore-part which is convex before, concave backwards, horizontal and plain in moſt of them above and below; their anterior and poſterior Surfaces having ſeveral remarkable Holes made in their thin external Plate, both for the firmer Connexion of the Ligaments, and for the Paſſage of Veſſels into their cellular Subſtance.—— The Edges of the Body of each *Vertebra* are covered, eſpecially at the Fore-part, with a Ring of Bone firmer and more ſolid than the Subſtance of the Body any where elſe. Theſe Rings ſeem to be joined to the *Vertebræ* in the Form of *Epiphyſes*, but are alledged by *Fallopius* (*a*) to be the Ligaments oſſified. They are of great Uſe in preventing the ſpongy Bodies from being broken in the Motions of the Trunk.

Between the Bodies of each two adjoining *Vertebræ*, a Subſtance between the Nature of Ligament and Cartilage is interpoſed; which conſiſts of concentrical curve Fibres, the exterior of which are the moſt ſolid and hard; and they gradually become ſofter, till they are almoſt in the Form of a glairy Liquor in the Center; and therefore theſe Subſtances were not improperly called *ligamenta mucoſa* by the Ancients (*a*). The exterior fibrous Part of each is capable of being greatly extended, and of being compreſſed into a very ſmall Space, while the middle fluid Part is incompreſſible, or nearly ſo; and the Parts of this Ligament between the Circumference and Center approach in their Properties to either, in Proportion to their more ſolid, or more fluid Texture. The middle Point is therefore a *Fulcrum* or *Pivot* on which the Motion of a Ball and Socket may be made, with ſuch a gradual yielding of the Subſtance of the Ligament, in which ever Direction our Spines are moved, as ſaves the Body from violent Shocks and their dangerous Conſequences (*b*).—This ligamento-cartilaginous Subſtance is firmly fixed to the horizontal Surfaces of the Bodies of the *Vertebræ*, to connect them, in which it is aſſiſted by a ſtrong membranous Ligament, which lines all their concave Surface, and by ſtill a ſtronger Ligament that covers all their anterior convex Surface. *Blancard* (*c*) aſſures us, that he diſcovered this anterior Ligament to conſiſt of two Rows of tendinous *Fibres* decuſſating each other in Form of the Letter X, to be alternately diſpoſed through all the *Vertebræ*, that is, according to him, the 1, 3, 5, 7, *&c.* are ſimilar, and the 2, 4, 6, 8, *&c.* are diffe-

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† Στροφεῖς, σφόνδυλες, Spondyli, oſſa orbiculata; oſſa vertebrata, verticula.

(*a*) Obſervat. Anatom.

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(*a*) Galen de uſu, Part. lib. 12. cap. 16.
(*b*) Medical Eſſays and Obſerv. Vol. V. Art. 18.
(*c*) Anat. Reform. cap. 12.

rent from the firſt Claſs, but alike among themſelves.

We may lay it down as a general Rule, notwithſtanding ſome Exceptions, that the *Bodies* of the *Vertebræ* are ſmaller and more ſolid above, but as they deſcend, they appear larger and more ſpongy, and that the Cartilages between them are thick, and the ſurrounding Ligaments ſtrong in Proportion to the Largeneſs of the *Vertebræ*, and to the Quantity of Motion they perform: By which Diſpoſition the greater Weight is ſupported on the broadeſt beſt ſecured Baſe, and the Middle of our Body is allowed a large and ſecure Motion, which is of conſiderable Benefit to us.

From each Side of the Body of each *Vertebra*, a bony Bridge is produced backwards and to a Side; from the poſterior Extremity of which, one ſlanting Proceſs riſes, and another deſcends; the ſmooth, and what is generally the flatteſt Side of each of theſe four Proceſſes, which are called the *oblique* †, is covered with a ſmooth Cartilage, and the two inferior oblique Proceſſes of each *Vertebra* are fitted to, and articulated with, the two ſuperior or aſcending oblique Proceſſes of the *Vertebra* below.

From between the ſuperior and inferior oblique Proceſs of each Side, the *Vertebra* is ſtretched out laterally in Form of a Proceſs that is named *Tranſverſe*.

From the back Part of the Roots of the two oblique and of the tranſverſe Proceſs of each Side, a broad oblique bony Plate is extended backwards, where theſe meet, the ſeventh Proceſs of the *Vertebræ* takes its Riſe and ſtands out backwards; this being generally ſharp-pointed and narrow-edged, has therefore been called *Spinal* Proceſs, from which this whole Chain of Bones has got its Name.

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† Articulatorii, minimi.

Beſides the common Ligament which lines all the internal Surface of the ſpinal Proceſſes, as well as of the Bodies, there are particular Ligaments that connect the Proceſſes of each *Vertebra* with thoſe of that contiguous to it.

The Subſtance of the Proceſſes is conſiderably ſtronger and firmer, and has a thicker external Plate than that of the Bodies of the *Vertebræ*.

The ſeven Proceſſes conſidered conjunctly, as forming the poſterior Shares of the *Vertebræ*, are hollow at their anterior middle Part; which Concavity joined with that at the Back-part of the Bodies, makes a great *Foramen*, which anſwers to ſuch another in the *Vertebra* above and below: Therefore the *Foramina* of all the *Vertebræ* taken together, form a long great Conduit † which is widned or ſtraitned in Proportion to the Size of the *Medulla ſpinalis* which it contains.

In the lateral Bridges, which join the Bodies to the Proceſſes of each *Vertebra*, a ſemicircular Notch is obſervable both above and below; which exactly correſponds with others in the contiguous Bones, when the *Vertebræ* are joined, to form a round Hole in each Side between each two *Vertebræ*, through which the Nerves

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† Ἱερὰ σύριγξ, σωλὴν, Canalis.

that proceed from the *Medulla ſpinalis* and its Blood-veſſels paſs.

The Articulations then of theſe true *Vertebræ* are plainly double; for their Bodies are joined by *Synchondroſis*, and their oblique Proceſſes are articulated by the third ſort of *Ginglymus*. Hence it is evident that their Center of Motion is altered in different Poſitions of the Trunk: For when we bow forwards, the ſuperior moved Part bears entirely on the Bodies of the *Vertebræ*; if we bend back, the oblique Proceſſes ſupport the Weight; if we recline to one Side, we reſt uppon the oblique Proceſſes of that Side, and Part of the Bodies; if we ſtand erect, all the Bodies and oblique Proceſſes have their Share in our Support.

Hence it follows: 1. That becauſe the Joints, of which the Spine is compoſed, are ſo numerous, the *Medulla ſpinalis*, Nerves, Blood-veſſels, &c. are not liable to ſuch Compreſſion and Over-ſtretching in the Motion of the Trunk of the Body, as they would otherwiſe be, ſince ſeveral *Vertebræ* muſt be concerned in every Motion of the Spine; and thereſore a very ſmall Curvature is made at the Conjunction of any two *Vertebræ*. 2. That an erect Poſture is the ſureſt and firmeſt, becauſe the Surface of Contact of the *Fulcra* is largeſt, and the Weight is moſt perpendicular to them. 3. That the Muſcles which move the Spine act with greater Force in bringing the Trunk to an erect Poſture, than in drawing it to any other: For in bending forwards, backwards, or to a Side, the Muſcles which perform any of theſe Actions are nearer the Centers of Motion, conſequently the Lever with which they act, is ſhorter, than when the Center of Motion is on the Part of the *Vertebra*, oppoſite to that where theſe Muſcles are inſerted, which is the Caſe in raiſing the Trunk. This is extremely neceſſary, ſince in the Deflexions of the Spine from a perpendicular Bearing, the Weight of the Body ſoon inclines it which Way we deſign; whereas in raiſing us erect, this great Weight muſt be more than counteracted. 4. In calculating the Force exerted by the Muſcles which move the Spine, we ſhould with *Borelli* (*a*) and *Parent* (*b*) always make Allowance for the Action of the Cartilages between the *Vertebræ*, which muſt in every Motion from an erect Poſture, be ſtretched on one Side, and compreſſed on the other, to both which they will reſiſt; whereas in raiſing the Trunk, theſe Cartilages will aſſiſt by their ſpringy Force. 5. We are hence naturally led into the Reaſon of the *Phænomenon* obſerved by Mr. *Waſſe* (*c*), That our Height of Stature is increaſed in the Morning, and diminiſhed at Night: For the intermediate Cartilages of the *Vertebræ* being preſſed all Day long by the Weight of our Body, become more compact and thin in the Evening; but when they are relieved from this Preſſure in the Night, they again expand themſelves to their former Thickneſs; and ſeeing the Bulk of any Part muſt vary according to the different Diſtenſion or Repletion of the Veſſels compoſing it, we may underſtand how we become taller after a plentiful Meal, and decreaſe after Faſting or Evacuations, which Difference the *Ab-*

*bé*

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(*a*) De motu animal. pars 1. ſchol. ad Propoſ. 58.
(*b*) Hiſtoire de l'Acad. des Sciences 1702.
(*c*) Philoſoph. Tranſact. Num. 383. p. 87.

*bé Fontenu* (*d*) has proved to depend moſtly, if not ſolely, on the different Thickneſs of theſe Cartilages. 6. From the different Articulations of the Bodies, and oblique Proceſſes of the *Vertebræ*, and the different Strength of the Ligaments, it is plain that they are formed ſo as to allow of a much larger Motion forwards, than backwards; this laſt being of much leſs Uſe, and might be dangerous, by overſtretching the large Blood-veſſels that are contiguous to the Bodies of the *Vertebræ*.

The *Vertebræ* at the ordinary Time of Birth conſiſt each of three bony Pieces, connected by tilages; to wit, the *Body*, which is not fully oſſified, and a long crooked Bone on each Side, on which we ſee a ſmall Share of the bony Bridge, the oblique Proceſſes complete, the beginning tranſverſe Proceſſes, and the oblique Plate, but no ſpinal Proceſs; ſo that the Teguments might be in no Danger of being hurt by the ſharp Extremities of theſe ſpinal Proceſſes, while a Child is in its bended Poſture in the Womb, nor while it is ſqueezed in the Birth.

From this general Mechaniſm of the Spine, an Account is eaſily deduced of all the different preternatural Curvatures which the Spine is capable of: For if one or more *Vertebræ* are of unequal Thickneſs in oppoſite Sides, the Spine muſt be reclined over to the thinner Side; which now ſuſtaining the greateſt Share of the Weight, muſt ſtill be more compreſſed, conſequently hindred from extending itſelf in Proportion to the other Side, which, being too much freed of its Burden, has Liberty to enjoy a

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(*d*) Hiſtoire de l'Acad. des Sciences 1725.

a luxuriant Growth. The Cauſes, on which ſuch an Inequality of Thickneſs in different Sides of the *Vertebræ* depends, may vary: For either it may be owing to an Over-diſtenſion of the Veſſels of one Side, and from thence a preternatural Increaſe of the Thickneſs of that Part; or which more commonly is the Caſe, it may proceed from an Obſtruction of the Veſſels, by which the Application of proper Nouriſhment to the bony Subſtance is hindred, whether that Obſtruction depends on the faulty Diſpoſition of the Veſſels or Fluids, or if it is produced by an unequal mechanical Preſſure, occaſioned by a paralytick Weakneſs of the Muſcles and Ligaments, or by a ſpaſmodic Over-action of the Muſcles on any Side of the Spine, or by People continuing long, or putting themſelves frequently into any particular Poſture declining from the erect one: In all theſe Caſes one common Effect will follow, to wit, the *Vertebræ* will turn thick on that Side where the Veſſels are free, and remain thin on the other Side where the Veſſels are ſtraitned or obſtructed.—— Whenever any morbid Curvature is thus made, a ſecond Turn, but in an oppoſite Direction to the former, muſt be formed. Both becauſe the Muſcles on the convex Side of the Spine being ſtretched, muſt have a ſtronger natural Contraction to draw the Parts to which their Extremities are fixed, and becauſe the Patient will make Efforts to keep the Center of Gravity of his Body perpendicular to its Baſe, that the Muſcles may be relieved from a conſtant violent contractile State, which always creates Uneaſineſs and Pain.

When once we underſtand how theſe crooked ed Spines are produced, there will be little Difficulty in forming a juſt Prognoſis, and a proper Method of Cure may be eaſily contrived, which muſt vary as to the internal Medicines, according to the different Cauſes on which the Diſeaſe depends; but one general Indication muſt be purſued by Surgeons, which is to counteract the bending Force, by increaſing the Compreſſion on the convex Part of the Curvature, and diminiſhing it on the concave Side. The Manner of executing which in particular Caſes muſt be very different, and requires a very particular Examination of the Circumſtances both of the Diſeaſe and Patient. In many ſuch Caſes, I have found ſome ſimple Directions, as to Poſtures in which the Patient's Body ſhould be kept, of very great Advantage.

Hence alſo it is eaſy to deduce the Reaſon, why old People generally bow forwards, and at laſt become incapable to raiſe their Spines erect; ſince the Cartilages ſhrivel in becoming more ſolid: And as this muſt happen moſt and ſooneſt where theſe Griſtles are leaſt ſtretched and extended, therefore this Curvature is generally firſt moſt remarkable in the *Vertebræ* of their Back, or they become round-ſhoulder'd.

Tho' the true *Vertebræ* agree in the general Structure which I have hitherto deſcribed, yet becauſe of ſeveral Specialities proper to a particular Number, they are commonly divided into three Claſſes, *viz. Cervical*, *Dorſal* and *Lumbar*.

The *Cervical* † are the ſeven ſuperior *Vertebræ*; which are diſtinguiſhed from the reſt by theſe Marks.——They are all, except the firſt, of near an equal Breadth.——Their Bodies are ſmaller and more ſolid than any others, and flatned on the Fore-part, to make way for the *OEſophagus*; or rather this flat Figure is owing to the Preſſure of that Pipe, and to the Action of the *longi Colli* and anterior *recti* Muſcles.——The poſterior Surface, which is alſo flat, is generally rough, or has ſmall Proceſſes riſing from it, where the Ligaments are fixed.——The upper Surface of the Bodies of each *Vertebra* is made hollow, by a ſlanting thin Proceſs which is raiſed on each Side:——The lower Surface is alſo excavated, but in a different Manner from the former; for the poſterior Edge is raiſed a little, and the anterior is produced a conſiderable Way. Hence we ſee how the Cartilages between thoſe Bones are more firmly connected, and the Articulations of any two *Vertebræ* are more ſecure.

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† Τράχηλȣ, αὐχὴν, Colli.

The Cartilages between theſe *Vertebræ* are thicker, eſpecially in reſpect of their Bulk, than thoſe belonging to the *Vertebræ* of the *Thorax*, becauſe of the larger Motion that is allowed here; and they are thickeſt at their Fore-part, which is one Reaſon why the *Vertebræ* advance forward, as they deſcend.

The oblique Proceſſes of theſe Bones of the Neck more juſtly deſerve that Name, than thoſe of any other *Vertebræ*. They are ſituated ſlanting, the ſuperior Proceſſes having their ſmooth and almoſt flat Surfaces facing obliquely backwards and upwards, while the inferior oblique Proceſſes have theſe Surfaces facing obliquely forwards and downwards.

The tranſverſe Proceſſes of theſe *Vertebræ* are framed in a different Manner from thoſe of any other Bones of the Spine: For beſides the common Proceſs, riſing from between the oblique Proceſſes of each Side, there is a ſecond that comes out from the Side of the Body of each *Vertebra*; and the two Proceſſes, after leaving a circular Hole for the Paſſage of the cervical Artery and Vein, being united, are conſiderably hollowed at their upper Part, with riſing Sides to protect the Nerves that paſs in the Hollow; and at laſt each Side terminates in an obtuſe Point, for the Inſertion of Muſcles.

The ſpinal Proceſſes of theſe cervical Bones ſtand nearly ſtreight backwards, are ſhorter than thoſe of any other *Vertebræ*, and are forked or double at their Extremity; and hence allow a more convenient Inſertion to Muſcles, and a larger Motion backwards.

The Holes between the bony croſs Bridges, for the Paſſage of the Nerves from the *Medulla ſpinalis*, have their largeſt Share formed in the loweſt of the two *Vertebræ*, to which they are common.

The Subſtance of the cervical *Vertebræ*, eſpecially of their Bodies, is not ſo porous or tender as of the other two Claſſes.

So far the cervical *Vertebræ* agree in their general Characteriſticks, but ſtill have ſome particular Differences, which oblige us to conſider them ſeparately.

The firſt, from its Uſe of ſupporting the Head, has got the Name of *Atlas* †; and by ſeveral Authors is called *Epiſtrophea*, from the Motion it performs on the ſecond.

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† Αστράγαλος.

The *Atlas*, contrary to all the other *Vertebræ* of the Spine, has no Body; but inſtead of it there is a bony Arch.——In the convex Fore-part of which, a ſmall Riſing appears, where the *Muſculi longi colli* are inſerted; and on each Side of this Protuberance a ſmall Cavity may be obſerved, where the *Recti interni minores*, commonly (tho' unjuſtly) aſcribed to *Cowper*, take their Riſe.—— The upper and lower Parts of the Arch are rough and unequal, where the Ligaments that connect this *Vertebra* to the *Os occipitis*, and to the ſecond *Vertebra* are fixed.—The Back-part of the Arch is concave, ſmooth, and covered with a Cartilage in a recent Subject, to receive the Tooth-like Proceſs of the ſecond *Vertebra*. This Hollow makes the Paſſage for the *Medulla ſpinalis* ſeem much larger in this *Vertebra* than in any other. On each Side of it a ſmall rough Sinuoſity may be remarked, where the Ligaments going to the Sides of the Tooth-like Proceſs of the following *Vertebra* are faſtned; and on each Side a ſmall rough Protuberance and Depreſſion is obſervable, where the tranſverſe Ligament, which ſecures the Tooth-like Proceſs in the Sinuoſity, is fixed, and hinders that Proceſs from injuring the *Medulla ſpinalis* in the Flexions of the Head.

The *Atlas* has as little of a ſpinal Proceſs as of a Body; but inſtead thereof there is a large bony Arch, that the Muſcles which paſs over this *Vertebra* at that Place, might not be hurt in extending the Head back. On the poſterior and upper Part of this Arch there are two Depreſſions, where the *Recti poſtici minores* take their Riſe; and at the lower Part are two other Sinuoſities, into which the Ligaments, which connect this Bone to the following one, are fixed.

The ſuperior oblique Proceſſes of this *Atlas* are large oblong and hollow, riſing more in their external than internal Brim; by which their Articulations with the *Condyloid* Proceſſes of the *Os occipitis* are firmer; for, as I remarked from *Galen (a)*, in the Deſcription of theſe *Condyles*, they cannot ſlip to either Side; and this Protuberance ſerves to defend the *Foſſa* or Channel formed behind the external and poſterior Part of each of them, in which the vertebral Arteries make the circular Turn, as they are about to enter the great *Foramen* of the occipital Bone, and where the tenth Pair of Nerves goes out.——— The inferior oblique Proceſſes are large, extended from within outwards and downwards, and are circular at their ſmooth Extremity where they are ſlightly hollowed: So that this *Vertebra* contrary to the other ſix, receives the Bones with which it is articulated both above and below.

The tranſverſe Proceſſes are not much hollowed or forked, but are longer and larger than thoſe of any of the other *Vertebræ colli*, to ſerve for the Origin and Inſertion of ſeveral Muſcles. The Muſcles fixed to the tranſverſe Proceſſes that ſerve to move this *Vertebra* on the ſecond, gain a conſiderable Lever to act with, by the Diſtance which each of theſe long Proceſſes makes of the Inſertion of the Muſcles from the *Axis* of Revolution.

The *Condyles* of the *Os occipitis* move forwards and backwards in the ſuperior oblique Pro-

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(*a*) De uſu partium, lib. 12. cap. 7.

Proceſſes of this *Vertebra*, by means of their double *Arthrodia*, which makes what I called the third Species of *Ginglymus*; but very little Motion can here be allowed of to either Side, and there muſt be ſtill leſs of a circular Motion, which the *Head* obtains principally by the Circumvolution of the *Atlas* on the ſecond *Vertebra*.

In new born Children this *Vertebra* has only the two lateral Pieces oſſified, the anterior Arch, which it has inſtead of a Body, being cartilaginous.

The ſecond *Vertebra colli* is called *Dentata*, from the Tooth-like Proceſs on the upper Part of its Body. Some Authors call it *Epiſtrophea*; but improperly, ſince this Deſignation is only applicable to the firſt, which moves on this as on an Axis.

The Body of this *Vertebra* is ſomewhat of a pyramidal Figure, being large, and produced downwards, eſpecially at its Fore-ſide, to enter into a Hollow of the *Vertebra* below; while the upper Part has a ſquare Proceſs, with a ſmall Point ſtanding out from it. This it is that is imagined to reſemble a Tooth †, and has given Name to the *Vertebra*.——The anterior Surface of this Proceſs is cylindrical, ſmooth, and covered with a Cartilage, where it plays in the Hollow of the anterior Arch of the firſt *Vertebra*.——The poſterior Surface is much of the ſame Form for moving on the Ligament which is extended tranſverſely from one rough Protuberance of the firſt *Vertebra* to the other, and is cartilaginous in the Middle, where this Tooth-like

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† Conoides, Pyrenoides, Odontoides.

like Proceſs plays on it.——A Ligament likewiſe goes out in an oblique tranſverſe Direction, from each Side of the *Proceſſus dentatus*, to be fixed at its other Extremity to the firſt *Vertebra*, and to the occipital Bone; and another ſtrong Ligament riſes up from the Point of the Proceſs to the *Os Occipitis.*——Immediately below the two lateral Ligaments a Sinuoſity may be obſerved on each Side, where the firſt vertebral Nerves eſcape.

The ſuperior oblique Proceſſes of this *Vertebra dentata* are large, circular, very near in an horizontal Poſition, and ſlightly convex, to be adapted to the inferior Proceſſes of the firſt *Vertebra.*—— A moveable Cartilage is ſaid by ſome Authors to be interpoſed between theſe oblique Proceſſes of the firſt and ſecond *Vertebra*, but I could never find it.—— The inferior and oblique Proceſſes of this *Vertebra dentata* anſwer exactly to the Deſcription given of thoſe common to all the cervical *Vertebræ*.

The tranſverſe Proceſſes differ from thoſe of the other cervical *Vertebræ* in this, that they are ſhorter, very little hollowed at their upper Part, and not forked at their Extremities; and that the Canals through which the cervical Arteries paſs, are reflected outwards about the middle Subſtance of the Proceſs, ſo that the Courſe of theſe Veſſels may be directed towards the tranſverſe Proceſſes of the firſt *Vertebra*; which are further produced, and therefore make a Turn of the Arteries neceſſary. - Had this Structure obtain'd in a Part ſo moveable as the Neck is, while the Artery was not defended by a Bone, and fixed to that Bone, ſcarce a Motion could have been performed without the utmoſt Hazard of Compreſſion, and a Stop put to the Courſe of the Liquids, with all its Train of bad Conſequences. Hence we obſerve this ſame Mechaniſm ſeveral times made uſe of, when there is any Occaſion for a ſudden Curvature of a large Artery. This is the third remarkable Inſtance of it we have ſeen: The firſt was the Paſſage of the *Carotides* through the *Oſſa temporum*: and the ſecond was that lately deſcribed in the vertebral Arteries, turning round the oblique Proceſſes of the firſt *Vertebra*, to come at the great *Foramen oſſis occipitis*.

The ſpinal Proceſs of this *Vertebra dentata* is thick, ſtrong and ſhort, to give ſufficient Origin to the *Muſculi recti majores*, and *obliqui inferiores*, and to prevent the Contuſion of theſe Muſcles in pulling the Head back.

This ſecond *Vertebra* conſiſts, at the Birth, of four bony Pieces; for beſides the three which I already mentioned as common to all the *Vertebræ*, the Tooth-like Proceſs of this Bone is begun at this Time to be oſſified in its Middle, and is joined as an Appendix to the Body of the Bone. Hence we may deduce one good Reaſon, why Nurſes ought to keep the Heads of New-born Children from falling too far backwards, by *Stay-bands* or ſome ſuch Bandage, till the Muſcles attain Strength ſufficient to prevent that dangerous Motion.

When we are acquainted with the Structure and Articulations of the firſt and ſecond *Vertebræ*, and know exactly the Strength and Connection of their Ligaments, there is no Difficulty in underſtanding the Motions that are performed upon or by the firſt, tho' this Subject was formerly Matter of hot Diſpute among ſome of the greateſt Anatomiſts. 'Tis none of my purpoſe at preſent to enter into a Detail of the Reaſons advanced by either Party, but to explain the Fact, as any one may ſee it, who will remove the Muſcles, which in a recent Subject hinder the View of theſe two Joints, and then will turn the Head into all the different Poſitions it is capable of. The Head may then be ſeen to move forwards and backwards on the firſt *Vertebra*, as was already ſaid; while the *Atlas* performs the *Circumgyratio* upon the ſecond *Vertebra*, the inferior oblique Proceſſes of the firſt *Vertebra* ſhuffling eaſily in a circular Way on the ſuperior oblique Proceſſes of the ſecond, and its Body or anterior Arch having a Rotation on the Tooth-like Proceſs, by which the perpendicular Ligament that is ſent from the Point of the Tooth-like Proceſs to the occipital Bone is twiſted, while the lateral Ligaments that fix the *Proceſſus dentatus* to the Sides of the firſt *Vertebra*, and to the *Os occipitis*, are very differently affected; for the one upon the Side towards which the Face is turned by the *Circumgyratio*, is much ſhortned and lax, while the oppoſite one is ſtretched and made tenſe, and yielding at laſt no more, prevents the Head from turning any further round on this *Axis*; ſo that theſe lateral Ligaments are the proper *Moderators* of the *Circumgyratio* of the Head here, which muſt be larger or ſmaller as theſe Ligaments are ſtronger or longer, and more or leſs capable of being ſtretched.—— Beſides this Revolution on this *Axis*, the firſt *Vertebra* can move a ſmall Way to either Side, but is prevented from moving backwards and forwards by its anterior Arch and by the croſs Ligament which are both cloſly applied to the Tooth-like Proceſs. Motion forwards here would have been of very bad Conſequence, as it would have brought the Beginning of the *Medulla ſpinalis* upon the Point of the Tooth-like Proceſs.

The Rotatory Motion of the Head is of great Uſe to us on many Accounts, by allowing us ſo quickly to apply our Organs of Senſe to Objects, and the *Axis* of Rotation was altogether proper to be at this Place; for if it had been at a greater Diſtance from the Head, the Weight of the Head, if it had at any time been removed from a perpendicular Bearing to the ſmall very moveable Joint, and thereby had acquired a long Lever, would, at every Turn inconſiderately performed, have broke the Ligaments; or theſe Ligaments muſt have been formed much ſtronger than could have been connected to ſuch ſmall Bones: Neither could this circular Motion be performed on the firſt *Vertebra* without Danger, becauſe the immoveable Part of the *Medulla oblongata* is ſo near, as at each large Turn the Beginning of the *Medulla ſpinalis* would have been in danger of twiſting, and ſuffering by the Compreſſion this would have made on its tender Fibrils.

It is neceſſary to obſerve that the *lateral* or *moderator* Ligaments confine ſo much the Motion of the firſt *Vertebra* upon the ſecond, that, though this Joint may ſerve us on ſeveral Occaſions, yet we are often obliged to turn our Faces farther round than this Joint alone can allow, without the greateſt Danger of twiſting the ſpinal Marrow too much, and alſo of luxating the oblique Proceſſes; therefore, in large Turns of this kind, the Rotation is aſſiſted by all the *Vertebræ* of the Neck and Loins; and if this is not ſufficient, we employ moſt of the Joints of the lower Extremities.—— This Combination of a great many Joints towards the Performance of one Motion, is alſo to be obſerved in ſeveral other Parts of the Body; notwithſtanding that ſuch Motions are generally ſaid to be performed by ſome ſingle Joint only.

The third *Vertebra* of the Neck is by ſome called *Axis*; but this Name is applied to it with much leſs Reaſon than to the ſecond.—— This third and the three below have nothing particular in their Structure, but all their Parts come under the general Deſcriptions formerly given, each of them being larger as they deſcend.

The ſeventh * *Vertebra* of the Neck comes near to the Form of thoſe of the Back, having the upper and lower Surfaces of its Body leſs hollow than the others:— The oblique Proceſſes are more perpendicular;— neither ſpinal nor tranſverſe Proceſſes are forked.—— This ſeventh and the ſixth *Vertebra* of the Neck have the Hole in each of their tranſverſe Proceſſes more frequently divided by a ſmall croſs Bridge, that goes between the cervical Vein and Artery, than any of the other *Vertebræ*.

The twelve *Dorſal* † may be diſtinguiſhed from the other *Vertebræ* of the Spine by the following Marks.

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* Atlas quibuſdam, maxima, magna Vertebra, prominens.

† Θώρακος, μεταφρένου, νώτου, ὑποτραχήλιου, Antiſterni, pectoris, tergi.

Their Bodies are of a middle Size, betwixt thoſe of the Neck and Loins;—— they are more convex before than either of the other two Sorts, and flatted laterally by the Preſſure of the Ribs, which are inſerted into ſmall Cavities formed in their Sides. This flatting on their Sides, which makes the Figure of theſe *Vertebræ* almoſt an half Oval, is of good Uſe, as it affords a firmer Articulation to the Ribs, allows the *Trachea arteria* to divide at a ſmaller Angle, and the other large Veſſels to run ſecure from the Action of the vital Organs.—— Theſe Bodies are more concave behind than any of the other two Claſſes. —Their upper and lower Surfaces are horizontal.

The Cartilages interpoſed between the Bodies of theſe *Vertebræ* are thinner than in any other of the true *Vertebræ*, and contribute to the Concavity of the Spine here at its Fore-part, by their being thinneſt near the anterior Edge of the *Vertebræ*.

The *oblique* Proceſſes are placed almoſt perpendicular, the ſuperior ſlanting but a little forwards, and the inferior as much backwards.— Neither they, nor the oblique Proceſſes of the Bones of the Neck, have as much Convexity or Concavity as is worth remarking.— A ſmall Roughneſs is obſervable at their Roots, where the Ligaments that ſurround their Articulations are inſerted;—— Between the oblique Proceſſes of oppoſite Sides, ſeveral ſharp Proceſſes ſtand out from the upper and lower Parts of the Plates, which join to form the ſpinal Proceſs; into theſe ſharp Proceſſes ſtrong Ligaments are fixed, for connecting the *Vertebræ*.

The *tranſverſe* Proceſſes of the *dorſal Vertebræ* are long, thicker at their Extremity than in the Middle, and turned obliquely backwards, which may be owing to the Preſſure of the Ribs, the Tubercles of which are inſerted into a Depreſſion near the Extremity of theſe Proceſſes.

The *Spinal* Proceſſes are long, ſmall-pointed, and run ſloping downwards and backwards; from the upper Part of their poſterior Surface, a ſmall Ridge riſes, which is received by a ſmall Channel in the anterior Surface of the ſpinal Proceſs immediately above, which is connected to it by a Ligament. Hence but little Motion can be allowed of here, leſt the Heart and Lungs ſhould be diſturbed in their Actions.

The *Conduit* of the *Medulla ſpinalis* is here more circular, but correſponding to the Size of that Cord, is ſmaller than in any of the other *Vertebræ*; and a larger Share of the Holes in the bony Bridges, for the Tranſmiſſion of the Nerves is formed in the *Vertebra* above, than in the one below.

The Bodies of the four ſuperior *dorſal Vertebræ* deviate from the Rule of the *Vertebræ*, becoming larger as they deſcend; for the firſt of theſe four is the largeſt, and the other three below gradually become ſmaller, to allow the *Trachea* and large Veſſels to divide at ſmaller Angles.

The two uppermoſt *Vertebræ* of the Back, inſtead of being very prominent forwards, are flatted by the Action of the *Muſculi longi colli* and *recti majores*.

The proportional Magnitude of the two little Depreſſions in the Body of each *Vertebra* for receiving the Heads of the Ribs, ſeems to vary in the following Manner: The Depreſſion on the upper Edge of each *Vertebra* decreaſes as far down as the fourth, and after that increaſes.

The tranſverſe Proceſſes are longer in each lower *Vertebra* to the ſeventh or eighth, with their ſmooth Surfaces, for the Tubercles of the Ribs, facing gradually more downwards; but afterwards as they deſcend become ſhorter, and the ſmooth Surfaces are directed more upwards.

The ſpinous Proceſſes of the *Vertebræ* of the Back become gradually longer and more ſlanting from the firſt, as far down as the eighth or ninth *Vertebra*, from which they manifeſtly turn ſhorter and more erect.

The firſt **Vertebra*, beſides an oblong Hollow in its inferior Edge, that aſſiſts in forming the Cavity, wherein the ſecond Rib is received, has the whole Cavity for the Head of the firſt Rib formed in it.

The ſecond has the Name of *Axillary* †, without any thing particular in its Structure.

The eleventh ‡ often has the whole Cavity for the eleventh Rib in its Body, and wants the ſmooth Surfaces on each tranſverſe Proceſs.

The twelfth ⸸ always receives the whole

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* Λοφία, Gutturalis.

† Μασχαλιστὴρ.

‡ Ἀῤῥεπὴς, in neutram partem inclinans.

⸸ Διαζώστηρ, præcingens.

Head of the laſt Rib, and has no ſmooth Surface on its tranſverſe Proceſſes, which are very ſhort.—— The ſmooth Surfaces of its inferior oblique Proceſſes face outwards as the *Lumbar* do.—— And we may ſay in general, that the ſuperior *Vertebræ* of the Back come nearer in Reſemblance to thoſe of the Neck, while the inferior are liker to the *Lumbar*.

The Articulation of theſe *Vertebræ* of the Back with the Ribs, ſhall be more particularly conſidered after the Ribs are deſcribed. Only it may be proper now to remark, that the Ligaments which ſerve that Articulation, aſſiſt in keeping the *Vertebræ* more cloſely connected.

The loweſt Order of the *True Vertebræ* is the *Lumbar* †, which are five Bones that may be diſtinguiſhed from any others by theſe Marks; 1. Their Bodies, tho of a circular Form at their Fore-part, are ſomewhat oblong from one Side to the other, which may be occaſioned by the Preſſure of the large Veſſels, and of the *Viſcera* contiguous to that Part. The *Epiphyſes* on their Edges are larger, and therefore the upper and lower Surfaces of their Bodies are more concave than in the *Vertebræ* of the Back. 2. The Cartilages between theſe *Vertebræ* are much the thickeſt of any, and render the Spine convex within the *Abdomen*, by their greateſt Thickneſs being at their Fore-part. 3. The oblique Proceſſes are ſtrong and deep, thoſe in oppoſite Sides being almoſt placed in parallel Planes, the ſuperior, which are concave, facing inwards, and the convex inferior ones facing outwards; and therefore theſe *Vertebræ* re-

ceive

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† Ὀσφύος, ἰξύος, ψοιῶν, Renum, Lumborum.

receive each other above, and are received below, which is not ſo evident in the other two Claſſes already deſcribed. 4. Their tranſverſe Proceſſes are ſmall, long, and almoſt erect, for allowing a large Motion to each Bone, and ſufficient Inſertion to Muſcles, and for ſupporting and defending the internal Parts. 5. Betwixt the Roots of the ſuperior oblique and tranſverſe Proceſſes, a ſmall Protuberance may be obſerved, where ſome of the Muſcles that raiſe the Trunk of the Body are inſerted. 6. Their ſpinal Proceſſes are ſtrong, ſtreight and horizontal, with broad flat Sides, and a narrow Edge above and below, this laſt being depreſſed on each Side by Muſcles. And at the Root of theſe Edges, we ſee rough Surfaces for fixing the Ligaments. 7. The Canal for the *Medulla ſpinalis* which is divided here into a great Number of Cords, is rather larger in theſe Bones than in the *Vertebræ* of the Back. 8. The Holes for the Paſſage of the Nerves are more equally formed out of both the contiguous *Vertebræ* than in others; the ſuperior one furniſhes however the larger Share of it.

Both tranſverſe and ſpinal Proceſſes of the middlemoſt *Vertebra* of the Loins are longeſt and thickeſt; above and below they diminiſh: So that theſe Proceſſes of the firſt † and fifth ‡ are the leaſt, which is very neceſſary, eſpecially as to the tranſverſe Proceſſes of theſe two *Vertebræ*; for if they had been long, they would have ſtruck on the Ribs or *Oſſa Ilium*

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† Νεφρίτης, renalis.
‡ 'Αχαλίτης, fulciens,

or would have bruiſed the interpoſed Muſcles in the Deflexions of the Spine to a Side.

The *Epyphyſes* round the Edges of the Bodies of theſe *Vertebræ* are moſt raiſed in the two loweſt, which conſequently make them appear hollower in the Middle, than the others are.

The Body of the fifth *Vertebra* is rather thinner than that of the fourth.—— The ſpinal Proceſs of this fifth is ſmaller, and the oblique Proceſſes face more backwards and forwards, than in any other *Lumbar Vertebra.*

The true *Vertebræ* ſerve to give us an erect Poſture; to allow a ſufficient and ſecure Motion to the Head, Neck, and Trunk of the Body on all neceſſary Occaſions: and to ſupport and defend the *Viſcera* and other ſoft Parts.

After conſidering the Structure of the particular *Vertebræ*, and their mutual Connexion, we may obſerve a ſollicitous Care has been taken that they ſhall not be disjoined, but with great Difficulty; for either their Bodies enter ſo into each other, as to prevent their being diſplaced any how, as in the *Vertebræ* of the Neck; or theſe Bodies are prop'd on all Sides, as theſe of the *Back* are by the Ribs; or their Surfaces of Contact are ſo broad, and the Ligaments ſo ſtrong and firmly connected, as to render the Separation almoſt impracticable, as in the *Loins*; while the Depth and Articulation of the oblique Proceſſes are exactly proportioned to the Quantity of Motion, which the other Parts of the Bones will allow, or the Muſcles can perform: Yet as theſe oblique Proceſſes are ſmall, and therefore not capable of ſo ſecure a Conjunction as the larger Bodies, they may ſooner yield to a disjoining Force; but then their Diſlocation is not of near ſo bad Conſequence as the Separation of the Bodies would be: For by the oblique Proceſſes being diſlocated, the Muſcles, Ligaments and *Medulla ſpinalis* are indeed ſtretched; but the *Medulla ſpinalis* muſt be compreſſed, or entirely deſtroyed when the Body of the *Vertebra* is removed out of its Place.

The ***FALSE VERTEBRÆ*** compoſe the under Pyramid of the *Spine*. They are diſtinguiſhed from the Bones already deſcribed juſtly enough by this Epithet of *Falſe*, becauſe though each Bone reſembles the true *Vertebræ* in Figure, yet none of them contribute to the Motion of the Trunk of the Body, they being intimately united to each other, except at their lower Part, where they are moveable; whence they are commonly divided into two Bones, *Os ſacrum* and *Coccygis*.

***OS SACRUM*** [*], is ſo called, from being offered in Sacrifice by the Ancients, or rather becauſe of its Largeneſs in reſpect of the other *Vertebræ*. —This Bone is of an irregular triangular Shape, broad above, narrow below, convex behind, for the advantagious Origin of the Muſcles that move the *Spine* and Thigh backwards, and concave before, for enlarging the Cavity of the *Pelvis*.—In young Subjects it may be eaſily ſeparated into five Bones; nay, in Adults, ſome Veſtige of this Diviſion is obſervable on its anterior Surface, and within the great Canal that runs through the Middle of it; but on its back Part

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[†] Ἱερὸν, *σπονδύλος μεγάς* Hippocrat. *ὑποσπονδύλον* Oribas. Πλατὺ, Latum, Os clunium, Clavium.

and Sides, there are no ſuch evident Marks of a former Diviſion; however, we can ſtill determine the ſeveral Parts that belong to each of theſe Bones.

The anterior ſpongy Part of the *Os ſacrum*, analogous to the Bodies of the true *Vertebræ*, is ſmooth and flat before, to allow a larger Space for the contained *Viſcera*, without any Danger of hurting them; or this flat Figure may be owing to the equal Preſſure of theſe *Viſcera*, particularly of the laſt Gut.—— The back Part of it is almoſt ſtreight, without ſo large a Cavity as the *Vertebræ* have: The ſpinal Marrow, being now become ſmall, is ſeparated into a Number of Nerves, called from their Appearance *cauda equina*, which a ſmall Canal can eaſily contain.—— The Bridges between the Bodies and Proceſſes of this Bone, are much thicker, and in Proportion ſhorter, than in the former Claſs of Bones.—— The Strength of theſe croſs Bridges is very remarkable in the three ſuperior Bones, and is well proportioned to the incumbent Weight of the Trunk of the Body, which theſe Bridges ſuſtain, when we are erect, in a tranſverſe, conſequently an unfavourable, Situation.

There are only two oblique Proceſſes of the *Os ſacrum*, one ſtanding out on each Side, from the upper Part of the firſt Bone.—— Their plain erect Surfaces face backwards, and receive the inferior oblique Proceſſes of the laſt *Vertebra* of the Loins, to which theſe Proceſſes are connected by a ſtrong Ligament, which riſes from a ſcabrous Cavity round their Roots, where mucilaginous Glands are alſo lodged.

The tranſverſe Proceſſes here are all grown together into one large ſtrong oblong Proceſs on each Side; which, ſo far as it anſwers to the firſt three Bones, is very thick and divided into two irregular Cavities, by a long perpendicular Ridge.—— The anterior Cavity has commonly a thin cartilaginous Skin covering it in the recent Subject, and is adapted to the unequal Protuberance of the *Os Ilium*, and a ſtrong Ligament connects the Circumference of theſe Surfaces of the two Bones.— The poſterior Cavity is divided by a tranſverſe Ridge into two, where ſtrong ligamentous Strings that go from this Bone to the *Os ilium*, with a cellular Subſtance containing *Mucus*, are lodged.

The tranſverſe Proceſſes of the two laſt Bones of the *Os ſacrum* are much ſmaller than the former, and are rough and porous where the *Glutæi maximi* and *Pyriformes* Muſcles have their Origin; and to each, a ſtrong Ligament that is extended from the *Oſſa Ilium* and Tuberoſity of the *Iſchium*, is fixed.

The ſpinal Proceſſes of the three uppermoſt Bones of the *Os ſacrum* appear ſhort, ſharp, and almoſt erect, while the two inferior are open behind, and ſometimes a little Knob is to be ſeen on the fourth, though generally it is bifurcated without the two Legs meeting into a *Spine*, in which Condition alſo the firſt is often to be ſeen, and ſometimes none of them meet, but leave a *Sinus* or rather *Foſſa*, inſtead of a Canal, as *Verheyen* (a) remarks.——From the Sides of theſe ſpinal Proceſſes the *Muſculus ſacer* has its Riſe.

The Canal between the Bodies and Proceſſes

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(a) Anat. Tract. 5. cap. 9.

ſes of this Bone, for the *Cauda equina*, is triangular, and becomes ſmaller as it deſcends, as the *Cauda* alſo does.—— Below the third Bone this Paſſage is no more a complete bony Canal, but is open behind, and is only there defended by a ſtrong ligamentous Membrane ſtretched over it, which, with the Muſcles that cover it, and are very prominent on each Side, is a ſufficient Defence for the Bundle of Nerves within.

At the Root of each oblique Proceſs of this Bone, the Notch is conſpicuous, by which, and ſuch another in the laſt *Vertebra* of the Loins, a Paſſage is left for the twenty fourth ſpinal Nerve; and in viewing the *Os ſacrum* either before or behind, four large Holes appear in each Side in much the ſame Height, as where the Marks of the Union of its ſeveral Bones remain. Some of the largeſt Nerves of the Body paſs through the anterior Holes; but the poſterior are in a good Meaſure covered by ſtrong Membranes ſtretched on them, though they ſtill tranſmit larger nervous Filaments than ſome Authors would have us believe.—— The two uppermoſt of theſe Holes, eſpecially on the Foreſide, are the largeſt; and as the Bone deſcends, the Holes turn ſmaller. Sometimes a Notch is only formed at the lower Part in each Side of this Bone, and in other Subjects there is a Hole common to it and the *Os Coccygis*, thro' which the twenty ninth Pair of ſpinal Nerves paſſes, and frequently a bony Bridge is formed on the back Part of each Side by a Proceſs ſent up from the poſterior Part of the *Os Coccygis*, and joined to the little Knobs which the laſt Bone of the *Os ſacrum* has inſtead of a ſpinal

Proceſs; under this Bridge or *Jugum*, that twenty ninth Pair of ſpinal Nerves runs in its Courſe to the common Holes juſt now deſcrib'd.

The ſuperior Surface of the Body of the firſt Bone reſembles the *Vertebræ* of the Loins; but the ſmall fifth Bone is oblong tranſverſely, and hollow in the Middle of its lower Surface.

The Subſtance of the *Os ſacrum* is very ſpongy, without any conſiderable ſolid external Plates, and is lighter than any other Bone in the Body of the ſame Bulk; but is ſecured from Injuries by the thick Muſcles that cover it behind, and by the ſtrong ligamentous Membranes that cloſely adhere to it.—— As this is one of the moſt remarkable Inſtances of this Sort of Defence afforded a ſoft weak Bone, we may make this general Obſervation, That wherever we meet with ſuch a Bone, one or other, or both theſe Defences are made uſe of; the firſt to ward off any Injury, and the ſecond to keep the Subſtance of the Bone from yielding too eaſily.

This Bone is articulated above to the laſt *Vertebra* of the Loins, in the Manner that the *Lumbar Vertebræ* are joined; and therefore the ſame Motions may be performed here.—— The Articulation of the *Os ſacrum* at its inferior Part to the *Os Coccygis*, ſeems well enough adapted for allowing a conſiderable Motion to this laſt Bone, was it not much confined by the Ligaments which are produced from the Sides of the articulated Bones, to others which are immoveable.—— Laterally the *Os ſacrum* is joined to the *Oſſa Ilium*, by an immoveable *Synchondroſis*, or what almoſt de-ſerves the Name of a Suture; for the cartilaginous Cruſt on the Surface of the Bones is very thin, and both their Surfaces are ſo ſcabrous and unequal, as to be indented into each other, which makes ſuch a ſtrong Connection, that great Force is required to ſeparate them, after all the Muſcles and Ligaments are cut.—— Frequently the two Bones grow together in old Subjects.

The Uſes of the *Os ſacrum* are to ſerve as the common Baſe and Support of the Trunk of the Body, to guard the Nerves proceeding from the Extremity of the ſpinal Marrow, to defend the back Part of the *Pelvis*, and to afford a ſufficient Origin to the Muſcles which move the Trunk and Thigh.

The Bones that compoſe the *Os ſacrum* of Infants, have their Bodies ſeparated by a thick Cartilage, and each of theſe Bones conſiſts of three Pieces joined by Cartilage, as the *Vertebræ* do, the poſterior Extremities of the two lateral Pieces being ſcarce contiguous in any of them.

*OS COCCYGIS* †, or *Rump-bone*, is that triangular Chain of Bones depending from the *Os ſacrum*, each Bone becoming ſmaller as they deſcend, till the laſt ends almoſt in a Point. The *Os Coccygis* is convex behind, and concave before, from which crooked pyramidal Figure which was thought to reſemble a Cuckow's Beak, this Bone has got its Name.

This Bone conſiſts of four Pieces in People of a middle Age:——In Children very near the whole of it is Cartilage; in old Subjects, all the Bones are united, and become frequently one continued Bone with the *Os ſacrum*.

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† Ὀῤῥοπύγιον, ὄῤῥος, Caudæ Os, Spondylium, Os Cuculi.

The higheſt of the four Bones is the largeſt, with Shoulders extended farther to each Side than the Extremity of the *Os ſacrum*; which Enlargement ſhould, in my Opinion, ſerve as a diſtinguiſhing Mark to fix the Limits of either Bone, and therefore ſhould take away all Diſpute about reckoning the Number of Bones, which one or other of theſe two Parts of the *Falſe Vertebra* is compoſed of, which Diſpute muſt ſtill be kept up, as long as the Numbering five or ſix Bones in the *Os ſacrum*, depends upon the uncertain Accident of this broad-ſhoulder'd little Bone being united to, or ſeparated from it.—The upper Surface of this Bone is a litle hollow.——From the Back of that bulbous Part called it's Shoulders, a Proceſs often riſes up on each Side, to join with the bifurcated Spine of the fourth and fifth Bones of the *Os ſacrum*, to form the bony Bridge mentioned in the Deſcription of the *Os ſacrum*.—Sometimes theſe Shoulders are joined to the Sides of the fifth Bone of the *Os ſacrum*, to form the Hole in each Side common to theſe two Bones, for the Paſſage of the twenty ninth Pair of ſpinal Nerves.--Immediately below the Shoulders of the *Os Coccygis*, a Notch may be remarked in each Side, where the thirtieth Pair of the ſpinal Nerves paſſes.— The lower End of this Bone is formed into a ſmall Head, which very often is hollow in the Middle.

The three lower Bones gradually become ſmaller, and are very ſpongy, but are ſtrengthned by a firm ſtrong Ligament which covers them.—Their Extremities, by which they are articulated, are formed in the ſame Manner as thoſe of the firſt Bone are.

Between each of theſe four Bones, of young Subjects, a Cartilage is interpoſed, therefore their Articulation is analogous to that of the Bodies of the *Vertebræ* of the Neck; for, as has been above remarked, the lower Extremity of the *Os ſacrum*, and of each of the three ſuperior Bones, has a ſmall Depreſſion in the Middle, and the upper Part of all the Bones of the *Os Coccygis* is a little concave, and conſequently the interpoſed Cartilages are thickeſt in the Middle, to fill up both Cavities by which they connect the Bones more firmly.—When the Cartilages oſſify, the ſuperior Extremity of each Bone is formed into a Cavity exactly adapted to the protuberant lower Extremity of the Bone immediately above.—From this Sort of Articulation, it is evident, that, unleſs when theſe Bones grow together, all of them are capable of Motion, of which the firſt and ſecond, eſpecially this laſt, enjoys the largeſt Share.

The lower End of the fourth Bone terminates in a rough Point to which a Cartilage is appended.

Into the Sides of theſe Bones of the *Os Coccygis*, the *Coccygæi* Muſcles of *Douglas* (a), or rather of *Euſtachius* (b) are inſerted; and to them the ſtrong Ligaments extended from the *Oſſa Iſchium* are fixed, and from them a conſiderable Share of the *Muſculi levatores Ani* takes its Origin.

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(a) Myograph. chap. 40.
(b) Tab. 36. No. 45. 20.

The Subſtance of theſe Bones is very ſpongy, and in Children cartilaginous, there being only a Part of the firſt Bone oſſified in a new born Infant——Since therefore the *Levatores Ani* have not ſuch a firm Origin, nor the *Inteſtinum rectum* ſuch a ſtrong Support in Children, as in *Adults*, it would appear no unreaſonable Concluſion of *Spigelius (a)* and *Paaw (b)*, that the Weakneſs and Flexibility of this Part, may be one Cauſe why Children are more ſubject to a *Procidentia Ani* than old People.

From the Deſcription of this Bone, we ſee how little it reſembles the *Vertebræ*, ſince it ſeldom has Proceſſes, never has any Cavity for the *Medulla ſpinalis*, nor Holes for the Paſſage of Nerves. From the Connexion it has by ſtrong Ligaments to the *Oſſa innominata*, we may be convinced, that it cannot be moved to either Side, and that its Motion backwards and forwards is pretty much confined: Yet as the Ligaments can be ſtretched by a conſiderable Force, it is a great Advantage in the Excretion of the *Fæces alvinæ*, and much more in Childbearing, that this Bone ſhould remain moveable. *Paaw (c)* aſſures us from his repeated Experience, that he has ſeen very great Inconveniencies and Danger from this Bone not being allowed to recede backwards in the Time of Birth, and as ſpeedy a Delivery after aſſiſting the Head of the Child to puſh back the *Os Coccygis.*

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(*a*) De humani corp. fabric. lib. 2. cap. 32.
(*b*) De Oſſib. pars 2da. cap. 3.
(*c*) Ibid.

*cygis*. Nay *Deventer (d)* ſeems to put a large Share of the Art of Midwifery on the right Management of this Bone, and thinks the Rules he lays down for that Operation, among the greateſt Diſcoveries he made.—The Mobility of the *Os Coccygis* diminiſhing as People advance in Age, eſpecially when its Ligaments and Cartilages have not been kept flexible, by being ſtretched, is probably one Reaſon why the Women who are old Maids, before they marry, have generally hard Labour in Child-bed.

The *Os Coccygis* ſerves to ſuſtain the Extremity of the *Inteſtinum rectum*; and in order to perform this Office more effectually, it is made to turn with a Curve forwards, by which alſo the Bone itſelf as well as the Muſcles and Teguments is preſerved from any Injury, when we ſit with our Body reclined back.

The ſecond Part of the Trunk of the Skeleton, the *PELVIS*, is the cylindrical Cavity at the lower Part of the *Abdomen* formed by the *Os ſacrum*, *Os Coccygis* and *Oſſa innominata*, which laſt fall now therefore in Courſe to be examined. —Tho' the Name of theſe *OSSA INNOMINATA* †, contributes nothing to the Knowledge of their Situation, Structure or Office, yet they have been ſo long and univerſally known by it, that there is no occaſion for changing it.— They are two large broad Bones, which form the Fore-part and Sides of the *Pelvis*, and the inferior lateral Parts of the *Abdomen*.——Each of theſe Bones is evidently divided into three in Children; which are afterwards ſo intimate-

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(*d*) Operat. Chirurg. cap. 27.

(†) Σκελέων, προςφύσεις, Sacro conjuncta.

ly united, that ſcarce the leaſt Mark of their former Separation remains: This notwithſtanding, they are deſcribed as conſiſting each of three Bones, to wit the *Os Ilium*, *Iſchium* and *Pubis*, which I ſhall firſt deſcribe ſeparately, and then ſhall conſider what is common to any two of them, or to all the three.

*OS ILIUM* †, or Haunch-bone, is the ſuperior broad Bone that reaches about as far down as a tranſverſe Section of one Third of the great *Acetabulum* or Cavity with high Brims, into which the Head of the Thigh-bone is received.

The external Side of this Bone is unequally convex, and is called its *Dorſum*;——the internal concave Surface is by ſome (but improperly) named its *Coſta*.—— The ſuperior ſemicircular Edge, tipped with a Cartilage in the recent Subject, is named the *Spine*, into which the external or deſcending oblique Muſcle of the *Abdomen* is inſerted; and from it the internal aſcending-oblique and the tranſverſe Muſcles of the Belly, with the *Gluteus maximus*, *Quadratus Lumborum* and *latiſſimus Dorſi* have their Origin. *Winſlow (a)* is of Opinion, that it is only the tendinous Cruſt of all theſe Muſcles, and not a Cartilage, as commonly alledged, that covers this bony Edge.—The Extremities of the Spine are more prominent than the Surface of the Bone below them, therefore are reckoned Proceſſes.———From the Point of the anterior ſpinal Proceſs the *Sartorius* Muſcle has its Riſe, and from the Outſide of this Proceſs the *Muſ-*

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† Λαγόνων, κενέων, Scaphium, lumbare, clunium, clavium, anchas.

(*a*) Expoſition Anatomique du corps humain traité des Os frais, Sect. 96.

*culus faſcialis* takes its Origin.——The Inſide of the poſterior ſpinal Proceſs, and of Part of the Spine forward from that, is made flat and rough where the *Sacro-lumbalis* and *longiſſimus Dorſi* riſe.——Below the anterior ſpinal Proceſs another Protuberance ſtands out, which by its Situation may be diſtinguiſhed from the former, as *Baker (a)* has done, by adding the Epithet of *inferior*, where the *Muſculus rectus Tibiæ* has its Origin.——Betwixt theſe two anterior Proceſſes the Bone is hollowed, where the Beginning of the *Sartorius* Muſcle is lodged ſafe from external Injuries.—— Below the poſterior ſpinal Proceſs a ſecond Protuberance of the Edge of this Bone is in like Manner obſervable, which is cloſely applied to the *Os ſacrum*.——Under this laſt Proceſs a conſiderable large Niche is obſervable in the *Os Iliūm*, which with the ſtrong Ligament that is ſtretched over from the *Os ſacrum* to the *Iſchium* of the recent Subject forms a large Hole thro' which the great ſciatic Nerve and the poſterior crural Veſſels paſs, and are protected from any Compreſſion.

The external broad Side or *Dorſum* of the *Os Iliūm* is a little hollow towards the Forepart, farther back it is as much raiſed, then is conſiderably concave, and laſtly it is convex. Theſe Inequalities are occaſioned by the Actions of the Muſcles that are ſituated on this Surface.—— From behind the ſuperior anterior ſpinal Proceſs, in ſuch Bones as are ſtrongly marked by the Muſcles, a ſemicircular Ridge is extended to the hollow Paſſage of the ſciatic

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(*b*) Curſ. Oſteolog. demonſtr. 3.

tic Nerve. Between the Spine and this Ridge the *Glutæus maximus* takes its Riſe.—— Immediately from above the anterior inferior ſpinal Proceſs, a ſecond Ridge is ſtretched to the Niche. Between this and the former Ridge, the *Glutæus medius* has its Origin; and in the Space between the lower Ridge and the *Acetabulum* the *Glutæus minimus* is lodged.—— On the Outſide of the poſterior ſpinal Proceſſes, the *Dorſum* of the *Os Iliûm* is flat and rough, where part of the *Muſculus pyriformis* riſes.—— The loweſt Part of this Bone is the thickeſt, and is formed into a large Cavity with high Brims, to aſſiſt in compoſing the great *Acetabulum*, which ſhall be conſidered after all the three Bones that conſtitute the *Os innominatum* are deſcribed.

The internal Surface of the *Os Iliûm* is concave in its broadeſt Fore-part, where the internal Iliac Muſcle has its Origin, and ſome Share of the *Inteſtinum Iliûm* and *Colon* is lodged.—— From this large Hollow a ſmall Sinuoſity is continued obliquely forwards, at the Inſide of the anterior inferior ſpinal Proceſs, where the conjoined *Pſoas* and *Iliacus* Muſcles paſs.—— The large Concavity is bounded below by a ſharp Ridge, which runs from behind forwards; and being continued with ſuch another Ridge of the *Os Pubis*, forms a Line of Partition between the *Abdomen* and *Pelvis*.——

All the internal Surface of the *Os Iliûm*, behind this Ridge, is very unequal: for the upper Part is flat, but ſpungy, where the *ſacrolumbalis* and *longiſſimus dorſi* riſe.—— Below this a tranſverſe Ridge ſtands out, from which Ligaments go out to the *Os ſacrum*;—— Immediately below this Ridge the rough unequal

Cavities and Prominences are placed, which are exactly adapted to thoſe deſcribed on the Side of the *Os ſacrum* :—— In the ſame Manner the upper Part of this rough Surface is porous,for the firmer Adheſion of the ligamentous cellular Subſtance; while the lower Part is more ſolid, and covered with a thin cartilaginous Skin for its immoveable Articulation with the *Os ſacrum*.—— Round all this large unequal Surface Ligaments riſe to be fixed to the *Os ſacrum*, to ſecure more firmly the Conjunction of theſe Bones.

The Paſſages of the medullary Veſſels are very conſpicuous, both in the *Dorſum* and *Coſta* of many *Oſſa Ilium*; but in others they are inconſiderable.

Theſe Bones are thick at their poſterior and inferior Parts, but are generally exceeding thin and compact at their Middle, where they are expoſed to the Actions of the *Musculi glutæi* and *Iliacus internus*, and to the Preſſure of the Bowels contained in the Belly.—— The Subſtance of the *Oſſa Ilium* is moſtly cellular, except a thin external Table.

In a ripe Child the Spine of the *Os Ilium* is cartilaginous, and is afterwards joined to the Bone in Form of an *Epiphyſe* ;——The large lower End of this Bone is not completely oſſified.

*OS ISCHIUM* * is of a very irregular Figure, and is ſituated loweſt of thoſe that compoſe the *Os innominatum*,—— Its Extent might be marked by an horizontal Line drawn near through the Middle of the *Acetabulum*; for the upper bulbous Part of this Bone forms ſome leſs than the lower Half of that great Cavity, and the ſmall Leg of it riſes to much the ſame Height on the other Side of the great Hole common to this Bone and the *Os Pubis*. This Bone therefore is of about a middle Bulk between the other two Bones.

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* Coxæ, coxendicis, pixis.

From the upper thick Part of this *Os Iſchium* a ſharp Proceſs ſtands out backwards, from which chiefly the *Muſculus coccygæus* and *ſupeperior Gemellus* riſe, and the *Sacro-ſciatic* Ligament is fixed to it; this and the other Ligaments ſtretched between the *Os ſacrum* and *Coccygis*, and the *Oſſa innominata*, ſerve as a ſure Defence to the Sides of the *Pelvis*; and protect the ſciatic Nerve and poſterior crural Veſſels, while the contained Parts find in them a ſoft but ſtrong Support.

Immediately below this ſharp-pointed Proceſs, which ſome thence call *ſpinoſus*, a Sinuoſity is formed for the Tendon of the *Muſculus obturator internus* to play in.—— In a recent Subject this Pulley is covered with a ligamentous Cartilage, that by two or three ſmall Ridges points out the Interſtices of the Fibres in the Tendon of this Muſcle.—— The outer Surface of the Bone at the Root of this ſpinous Proceſs is made hollow by the *Pyriformis* or *Iliacus externus* Muſcle, and the Print of ſome Part of the *Obturator externus* may be ſeen at the lower Part of the Brim of the *Acetabulum*.

Below theſe Sinuoſities the great Tuberoſity, or Knob, on which we ſit, is conſpicuous, which has its Extremity made flat and ſmooth by the Preſſure it ſuffers, and in a recent Subject is covered with a Cartilage, or tendinous Subſtance rather, according to *Winſlow* (*a*); but its Baſe is rough, to afford convenient Origin to a great many Muſcles: For the inferior *Gemellus* riſes from the upper Part, the *Quadratus* from the anterior, the largeſt Head of the *Triceps* from the poſterior, and the *ſeminervoſus*, *ſemimembranoſus*, and long Head of the *Biceps*, from the inferior Part of this Tuberoſity; which, as it advances forwards, becomes ſmaller, but is ſtill rough, for the Origin of the *Erector penis*. From this flat Proceſs the *Os Iſchium* turning much ſmaller, and mounting up with a conſiderable Curve, is ſtretched out into its ſmall Leg, the Edge of which is rough and prominent, where the two lower Heads of the *Triceps* take their Riſe.

The Subſtance of the *Os Iſchium* is much the ſame as of the former Bone.

No other Bones are joined to the *Os Iſchium*, except the *Os Ilium* and *Pubis* of the ſame Side.

In an Infant the great thick Part of this Bone is in a cartilaginous State; and the ſpinous Proceſs, great Tuberoſity and recurved Leg, are all in the ſame Condition.—The *Tuber* is afterwards added in the Manner that other *Epiphyſes* are.

The *OS PUBIS* *, or Sharebone, is ſituated in the middle anterior and internal Part of the *OS innominatum*. The thick largeſt Part of this Bone is employed in forming the *Acetabulum*; from which becoming much ſmaller, it is ſtretched inwards to its Fellow of the

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(*a*) Expoſition Anatomique du corps humain, traité de Os frais, Sect. 96.

* Pectinis, penis, pudibundum, feneſtratum.

the other Side, where again it grows larger, and ſends a ſmall Branch downwards to join the Extremity of the ſmall Leg of the *Os Iſchium*.

On the upper Part of the *Os Pubis* a Ridge runs in a continued Line with ſuch another of the *Os Ilium*, which divides the *Abdomen* and *Pelvis*.—Near each End of this Ridge a ſmall Protuberance appears, to which the duplicated Tendon of the *Muſculus deſcendens abdominis*, commonly called the *Ligamentum Pubis*, is connected, leaving a Paſſage behind it for the *Pſoas* and *Iliacus internus* Muſcles, and for the anterior crural Veſſels and Nerves, in a ſmooth Depreſſion of the Bone. —— At the internal Part of this Concavity a ſmall Ridge riſes, where the *Muſculus rectus* and *pyramidalis* are inſerted; and from the oppoſite End of the Hollow, another Ridge runs obliquely outwards and downwards, towards the *Acetabulum*, to give Riſe to the *Pectineus*.--Immediately below where this Ridge is to take the Turn downwards, a winding Niche comprehended in the great *Foramen*, is formed in the *Os Pubis*, to allow a Paſſage for the poſterior crural Nerve, an Artery and a Vein.— The internal Extremity of the *Os Pubis* is rough and unequal, for the firmer Adheſion of the thick ligamentous Cartilage, that connects it to its Fellow of the other Side :—— The Proceſs which goes down from that to the *Os Iſchium* is broad and rough before, where the *Gracilis* and upper Heads of the *Triceps*, or rather *Quadriceps adductor femoris*, have their Origin.

The Subſtance of the *Os Pubis* is much akin to that of the two former Bones.

Only a Part of the large Extremity of this Bone is oſſified, and the whole Leg is cartilaginous in a Child born at the full Time.

Betwixt the *Os Iſchiûm* and *Pubis* a very large irregular *Foramen* is left, which, from its Reſemblance to a Door or Shield, has been called *Thyroides*. This Hole is all, except the Niche for the poſterior crural Nerve, filled up in a recent Subject with a ſtrong ligamentous Membrane, that adheres very firmly to the Circumference of this Hole: From this Membrane chiefly the two *Obturatores*, external and internal, take their Riſe.——The great Deſign of this *Foramen*, beſides rendring the Bone lighter, appears to be, to allow a ſtrong enough Origin to the *obturator* Muſcles, and ſufficient Space for lodging their Bellies, that there may be no Danger of diſturbing the Functions of the contained *Viſcera* of the *Pelvis* by the Actions of the internal, nor of the external being bruiſed by the Thigh-bone, eſpecially by its leſſer *Trochanter* in the Motions of the Thigh inwards: Both which Inconveniencies muſt have happened, had the *Oſſa innominata* been complete here, and of ſufficient Thickneſs and Strength to ſerve as the fixed Point of theſe Muſcles.

In the external Surface of the *Oſſa innominata*, very near the Outſide of the great *Foramen*, a large deep Cavity is formed by all the three Bones conjunctly: For the *Os Pubis* conſtitutes about one Fifth; the *Os Iliûm*, ſomething leſs than two Fifths, and the *Os Iſchiûm*, as much more than two Fifths. The Brims of this Cavity are very high, and are, in a recent Subject, ſtill much more enlarged by the ligamentous Cartilage, with which they are tipped.

From this Form of the Cavity it has been called *Acetabulum*; and for a diſtinguiſhing Character, the Name of the Bone that conſtitutes the largeſt Share of it is added; therefore *Acetabulum oſſis iſchii* † is the Name this Cavity commonly bears.——Round the Baſe of the *Supercilia* the Bone is rough and unequal, where the circular Ligament of the Articulation is fixed.——The Brims at the ſuperior and poſterior Circumference of the *Acetabulum* are much larger and higher than any where elſe; which is very neceſſary, to prevent the Head of the *Femur* from ſlipping out of its Cavity at this Place, where the whole Weight of the Body bears upon it, and conſequently would otherwiſe be conſtantly in danger of thruſting it out. ——As theſe Brims are extended downwards and forwards, they become leſs; and at their internal lower Part a Breach is made in them, at the Side of the great *Foramen*. From the one Side of which Breach to the other, a Ligament is placed in the recent Subject; under which a large Hole is left, which contains a fatty cellular Subſtance and Veſſels. The Reaſon of which Appearance has afforded Matter of Debate. To me it ſeems evidently contrived for allowing a larger Motion to the Thigh inwards: For if the bony Brims had been here continued, the Neck of the *Femur* muſt have ſtruck upon them when the Thighs were brought a-croſs each other, which, in a large ſtrong Motion this Way, would have endangered the Neck of the one Bone, or Brim of the other. Then the Veſſels which are diſtributed to the

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† Coxæ, coxendicis.

Joint may ſafely enter at the Sinuoſity in the Bottom of the Breach; which being however larger than is neceſſary for that Purpoſe, ſerves another very good Uſe, remarked by *Petit* *(a)*, which is, to allow the large mucaginous Gland of the Joint to eſcape below the Ligament, when the Head of the Thigh-bone is in hazard of preſſing too much upon it in the Motions of the Thigh outwards.—— Beſides this Difference in the Height of the Brims, the *Acetabulum* is otherwiſe unequal: For the inferior internal Part of it is depreſſed below the cartilaginous Surface of the upper Part, and has no ſmooth cartilaginous Surface; into its upper Part, where it is deepeſt, and of a ſemilunar Form, the Ligament of the Thigh-bone, which is commonly, tho' improperly, called the *round* one, is inſerted; while in its more ſuperficial lower Part the large mucilaginous Gland of this Joint is lodged. The largeſt Share of this ſeparate Depreſſion is formed in the *Os Iſchium*.

From what has been ſaid of the Condition of the three Bones compoſing this *Acetabulum* in new born Children, it muſt be evident that a conſiderable Part of this Cavity is cartilaginous in ſuch.

The *Oſſa innominata* are joined at their poſterior Part to each Side of the *Os ſacrum*, by a Sort of Suture with a very thin intervening Cartilage, which ſerves as ſo much Glue to cement theſe Bones together, and ſtrong Ligaments go from the Circumference of this unequal Surface, to connect them more firmly; the

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(*a*) Memoires de l'Acad. des Sciences, 1722.

the *Oſſa innominata* are connected together at their Forepart, by the thick firm Cartilage interpoſed between the two *Oſſa Pubis.*—Theſe Bones can therefore have no Motion in a natural State, except what is common to the Trunk of the Body or to the *Os ſacrum.* But it has been diſputed, whether or not they looſen ſo much from each other, and from the *Os ſacrum* in Child-birth, by the Flow of *Mucus* to the *Pelvis,* and by the Throws of the Labour, as that the *Oſſa Pubis* recede from each other, and thereby allow the Paſſage between the Bones to be enlarged.—The Experiments and Obſervations of *Spigelius (a)*, *Riolan (b)*, *Diemerbroeck (c)*, and others, ſhew that this Relaxation ſometimes happens; but *Hildan (d)*, *Dionis (e)*, *Morgagni (f)* and others, who had frequently Opportunities of diſſecting the Bodies of Women, who died immediately after being delivered of Children, teach us to beware of regarding this as the common Effect of Child-birth; for they found ſuch a Relaxation in very few of the Bodies, which they examined.—I have frequently applied my Fingers to the Teguments covering the Conjunction of the *Oſſa Pubis* in very laborious Births, but never could be ſenſible of any Separation or Motion of theſe Bones, nor could I obſerve it in the Bodies of ſome Women, who died ſoon after they were delivered of Children, when I applied

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(*a*) Anat. Lib. 2. Cap 34.
(*b*) Anthropograph. Lib. 6. Cap. 12.
(*c*) Anat. Lib. 9. Cap. 16.
(*d*) Epiſt. Cent. obſ. 46.
(*e*) Sixieme Demonſtr. des Os.
(*f*) Adverſ. 2. Animad. 15.

ed all my Strength to draw the *Oſſa Pubis* aſunder, and to make them ſhuffle backwards or forwards.

Conſidering what great Weight is ſupported in our erect Poſture, by the Articulation of the *Oſſa innominata* with the *Os ſacrum*, there is great Reaſon to think, that if the conglutinated Surfaces of theſe Bones were once ſeparated, the Ligaments would be violently ſtretched, if not torn; from whence many Diſorders would ariſe, ſuch as we have a particular Hiſtory of related by *Ludovicus (a).*——I have ſometimes ſuſpected a Relaxation of the Parts connecting the *Oſſa innominata* and *ſacrum*, in Women of a delicate tender Make, who after hard Labour complained of Pain, Weakneſs and of a Sort of jirking Motion in this Place, which I could not be in the leaſt ſenſible of with my Fingers. For ſeveral Months they could neither ſit nor ſtand without Pain, and they had a Weakneſs here much longer, complaining that they thought they were always ſinking down between the Haunch-bones.

Each *Os innominatum* affords a Socket (the *Acetabulum*) for the Thigh-bones to move in, and ſometimes we turn the Trunk of the Body on the Heads of the Thigh-bones.——This Articulation is to be more fully deſcribed after the *Oſſa Femoris* are examined.

We may now underſtand the Form and Size of the *Pelvis*, how ſtrongly it is fenced before, behind, and at each Side by Bones, for the Safety and Support of the contained *Viſcera*, and for the Origin and Inſertion of a great

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(a) Ephem. German. Dec. 1. Ann. 2. Obſerv. 254.

Number of Muſcles; but open above and with ſuch a Diſtance left between its Bones below, as may allow ſufficient Space for the large Excretories, the *Veſica urinaria*, *Inteſtinum rectum*, and in Women the *Uterus*, to diſcharge themſelves.

The *THORAX* †, or Cheſt which is the only Part of the Trunk of the Body which we have not yet deſcribed, reaches from below the Neck to the Belly; and by means of the Bones that guard it, is formed into a large Cavity: The Figure of which is ſomewhat conoidal; but its ſuperior ſmaller Extremity is not finiſhed, being left open for the Paſſage of the Windpipe, Gullet and large Blood-veſſels; and its inferior Extremity, or the Baſe, is unguarded with Bones, and is ſhorter before than behind; ſo that, to carry on our Compariſon, it appears like an oblique Section of the Conoid. Beſides which we ought alſo to remark, with *Albinus* (*a*), that the lower Part of this Cavity is narrower than ſome Way above; and that the Middle of the back Part of the Cavity is conſiderably diminiſhed by the Ribs turning forwards, and by the Bodies of the *Vertebræ* of the Back being prominent within the *Thorax*.

The Bones which form the *Thorax* are the twelve dorſal *Vertebræ* behind, the Ribs on the Sides, and the *Sternum* before.

The *Vertebræ* have already been deſcribed as Part of the Spine, and therefore are now to be paſſed.

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† Pectus, caſſum.

(*a*) De Oſſib. Sect. 169.

The *RIBS*, or *Coſtæ* †, (as if they were *Cuſtodes* or Guards to theſe principal Organs of the animal Machine, the Heart and Lungs) are the long crooked Bones placed at the Side of the Cheſt, in an oblique Direction downwards, in reſpect of the Back-bone.——Their Number is generally twelve on each Side, tho' frequently eleven or thirteen have been found.——I never ſaw fewer or more than the ordinary Number; but in the Skeleton of a Boy about eight Years old, now in my Poſſeſſion, the fourth and fifth Ribs of the left Side are grown together at their Roots for near an Inch, and afterwards dividing, have the ſame Appearance as the Ribs of the oppoſite Side, which are naturally formed.

The Ribs are all convex externally, and concave internally, where they are alſo made ſmooth by the Action of the contained Parts, which on this Account are in no Danger of being hurt by them.——The Extremities of the Ribs next the *Vertebræ* are rounder than they are after theſe Bones have advanced forwards, when they become flatter and broader, and have an upper and lower Edge, each of which is made rough by the Action of the *intercoſtal* Muſcles inſerted into them. Theſe Muſcles, being all of nearly equal Force, and equally ſtretched in the Interſtices of the Ribs, prevent the broken Ends of theſe Bones in a Fracture, from being removed far out of their natural Place to interrupt the Motion of the vital Organs.——The upper Edge of the Ribs is more obtuſe and rounder than the lower, which is depreſſed on its internal Side by a long *Foſſa*, for lodging the intercoſtal Veſſels and Nerves. This Channel is not obſervable however at either Extremity of the Ribs; for at the poſterior or Root, the Veſſels have not yet reached the Ribs, and at the anterior Extremity they are ſplit away into Branches, to ſerve the Parts between the Ribs, which plainly teaches Surgeons one Reaſon of the greater Safety of performing the Operation of the *Empyema* towards the Sides of the *Thorax*, than either near the Back or the Breaſt.

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† Πλευραὶ, περιστέρνα, σπάθαι.

At the poſterior Extremity † of each *Rib*, a little Head is formed, which is divided by a middle Ridge into two plain or hollow Surfaces, the loweſt of which is the broadeſt and deepeſt. The two Plains are joined to the Bodies of two different *Vertebræ*, and the Ridge forces itſelf into the intervening Cartilages. ——A little Way from this Head, we find on the external Surface a ſmall Cavity, where mucilaginous Glands are lodged; and round the Head the Bone appears ſpungy, where the circular Ligament of the Articulation is fixed.—— Immediately beyond this a flatted Tubercle riſes with a ſmall Cavity at, and Roughneſs about its Root, for the Articulation of the Rib with the tranſverſe Proceſs of the loweſt of the two *Vertebræ*, with the Bodies of which the Head of the Rib is joined.——Advancing further on this external Surface, we obſerve in moſt of the Ribs another ſmaller Tubercle, into which Portions of the *Longiſſimus dorſi* are inſerted.——Beyond this the Ribs are made flat by the *Sacrolumbalis* Muſcle, which is inſerted in-

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† Κώπιον, Remulus.

to the Part of this flat Surface fartheſt from the Spine, where each Rib makes a conſiderable Curve, called by ſome its *Angle.*——Then the Rib begins to turn broad, and continues ſo to its anterior Extremity †, which is hollowed and ſpungy, for the Reception of and firm Coalition with the Cartilage that runs thence to be inſerted into the *Sternum*, or to be joined with ſome other Cartilages.——In Adults, generally the Cavity at this Extremity of the Ribs is ſmooth and poliſhed on its Surface, by which the Articulation of the Cartilage with it would ſeem deſigned for Motion, which however is not allowed.

The Subſtance of the Ribs is ſpungy, cellular, and only covered with a very thin external lamellated Surface, which increaſes in Thickneſs and Strength as it approaches the *Vertebræ*.

To the anterior Extremity of each Rib a long broad and ſtrong Cartilage is fixed, and reaches thence to the *Sternum*, or is joined to the Cartilage of the next Rib. This Courſe however is not in a ſtreight Line with the Rib, for generally the Cartilages make a conſiderable Curve, the concave Part of which is upwards; therefore, at their Inſertion into the *Sternum*, they make an obtuſe Angle above, and an acute one below.——Theſe Cartilages are of ſuch a Length, as never to allow the Ribs to come to a right Angle with the Spine, but they keep them ſituated ſo obliquely as to make an Angle very conſiderably obtuſe above, 'till a Force exceeding the Elaſticity of the Cartilages is applied. ——

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† Πλάτη, Palmula.

——Theſe Cartilages, as all others, are firmer and harder internally, than they are on their external Surface; and ſometimes in old People, according to *Veſalius* (a), all their middle Subſtance becomes bony, while a thin cartilaginous *Lamella* appears externally, tho' the Oſſification begins much oftner at the external Surface.——The greateſt alternate Motions of the Cartilages being made at their great Curvature, that Part, as *Havers* (b) has remarked, remains frequently cartilaginous, after all the reſt is oſſified.

The Ribs then are articulated at each Extremity, of which the one behind is doubly joined to the *Vertebræ*, for the Head is received into the Cavities of two Bodies of the *Vertebræ*, by what I called the ſecond Species of *Ginglymus*; and the larger Tubercle is articulated to the tranſverſe Proceſs of the lower *Vertebra*, by what is commonly called *Arthrodia*, which I comprehended under the *Enarthroſis*; and if we were to conſider conjunctly both theſe Articulations of any Rib with the *Vertebræ*, it would come under the third Species of *Ginglymus*.——When one conſiders this double Articulation, he muſt immediately ſee, that no other Motion can here be allowed than upwards and downwards, ſince the tranſverſe Proceſs hinders the Rib to be thruſt back; the Reſiſtance on the other Side of the *Sternum*, prevents the Rib's coming forward; and each of the two Joints with the other Parts attached, oppoſe its turning round. But then it is likwiſe as evident, that even the

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(a) Lib. 1. cap. 19.
(b) Oſteolog. nov. Diſc. 5.

Motion upwards and downwards, can be but ſmall in any one Rib at the Articulation itſelf, tho' it may be very conſpicuous at the anterior Extremity, which moves in a Circle, whoſe *Radius* is the Length of the Rib.——If at the ſame time, we conſider how obliquely the Ribs are ſituated in reſpect of the *Vertebræ*, we muſt be convinced, that the Ribs cannot be raiſed without removing farther from the Backbone; and as a conſiderable Reſiſtance is made by the *Sternum* to their anterior Extremities, theſe Bones muſt, in moving upwards, be alſo turned outwards, as *Winſlow (a)* has proved. ——The anterior End of the Ribs has no proper moveable Articulation, except ſo far as the Cartilages between the *Sternum* and Ribs will yield, on which Account and becauſe of the Reſiſtance, ſuch Ribs as perform large Motions under theſe Diſadvantages, are commonly twiſted towards their anterior Extremities.

Hitherto I have laid down the Structure and Connexion which moſt of the Ribs enjoy, as belonging to all of them; but muſt now conſider the Specialities wherein any of them, either collectively or ſingly, differ from the general Deſcription given, or from each other.

In viewing the Ribs from above downwards, their Figure is ſtill ſtreighter, the uppermoſt being the moſt crooked of any.——Their Obliquity in reſpect of the Spine increaſes as they deſcend; ſo that tho' the Diſtance of their poſterior Extremities from each other is very little different, yet at their anterior Extremities the Diſtances between the lower ones muſt increaſe.

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(a) Memoires de l'Acad. des Sciences, 1720.

creaſe.——In conſequence too of this increaſed Obliquity of the lower Ribs, each of their Cartilages makes a greater Curve in its Progreſs from the Rib towards the *Sternum*, and the Tubercles, that are articulated to the tranſverſe Proceſſes of the *Vertebræ*, have their ſmooth Surface gradually facing more upwards. ——The Ribs becoming thus more oblique, while the *Sternum* advances forward in its Deſcent, makes the Diſtance between the *Sternum* and the anterior Extremity of the lower Ribs greater than between the *Sternum* and the Ribs above; conſequently the Cartilages of thoſe Ribs that are joined to the Breaſt-bone are longer in the higher than the lower ones.——Theſe Cartilages are placed nearer to each other as the Ribs deſcend, which aſſiſts in making the Curvature of the Cartilages greater.

The Length of the Ribs increaſes from the firſt or uppermoſt Rib, as far down as the ſeventh, and from that to the twelfth as gradually diminiſhes.——The ſuperior of the two plain, or rather hollow Surfaces, by which the Ribs are articulated to the Bodies of the *Vertebræ*, gradually increaſes from the firſt to the fourth Rib, and is diminiſhed after that in each lower Rib.——The Diſtance of their Angles from the Heads always increaſes as they deſcend to the ninth, becauſe of the greater Breadth of the *Sacrolumbalis* Muſcle. This is remarked by *Winſlow* (*a*).

The Ribs are commonly divided into True and Falſe.

The

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(*a*) Expoſition Anatomique des Os ſecs Sect. 643.

The *True* † *Coſtæ* are the ſeven upper ones of each Side, whoſe Cartilages are all gradually longer as the Ribs deſcend, and are joined to the Breaſt-bone; ſo that being preſſed conſtantly between two Bones, they are flatted at both Extremities, and are thicker, harder, and more liable to oſſify than the other Cartilages, that are not ſubject to ſo much Preſſure. Theſe Ribs include the Heart and Lungs, and therefore are the proper or true *Cuſtodes* of Life.

The Five inferior of each Side are the *Falſe*, or *BASTARD* ‡, whoſe Cartilages do not reach to the *Sternum*; and therefore, wanting the Reſiſtance at their anterior Extremities, they are there pointed; and on this Account having leſs Preſſure, their Subſtance is ſofter.——The Cartilages of theſe *falſe Ribs* are ſhorter as the Ribs deſcend.—— To all theſe five Ribs the circular Edge of the *Diaphragm* is connected; and its Fibres, inſtead of being ſtretched immediately tranſverſely, and ſo running perpendicular to the Ribs, are preſſed ſo as to be often, eſpecially in Exſpiration, parallel to the Plane in which the Ribs ly; nay, one may judge by the Attachments which theſe Fibres have ſo frequently to the Sides of the *Thorax*, a conſiderable Way above where their Extremities are inſerted into the Ribs, and by the Situation of the *Viſcera*, always to be obſerved in a dead Subject laid ſupine, that there is conſtantly a large Concavity formed on each Side by the *Diaphragm* within theſe baſtard Ribs, in which the Stomach, Liver, Spleen, *&c.* are contained, which being only reckoned among the *Viſcera naturalia*, have occaſioned the Name of *Baſtard Cuſtodes* to theſe Bones.

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† Γνήσιαι, Germanæ, legitimæ.

‡ Μαλθάκαι, Χονδρώδεις, ἄκανθαι, κλένες, εὔαι, Adulterinæ, ſpuriæ, illegitimæ.

Hence we may eaſily underſtand the Juſtice of *Hippocrates*'s (*a*) Rule in ſimple Fractures of the falſe Ribs, without a Fever, to keep the Stomach moderately filled with Food, leſt the pendulous Ribs falling inwards, ſhould thereby increaſe the Pain, Cough, &c. *Paré* (*b*) confirms the Truth of this Obſervation from his long Experience; but it is now-a-days much forgot, or entirely neglected.—— Hence likewiſe we may learn how to judge better of the Seat of ſeveral Diſeaſes, and to do the Operation of the *Empyema*, and ſome others, with more Safety, than we can do, if we follow the common Directions.

The uppermoſt, or *firſt* Rib, has ſeveral Specialities; ſome of them contradictory to any Character yet given of the Ribs: The Figure of it is much more curve than of any of the reſt; whence the Name of ἀπίϛρεφαι, *retortæ*, or crooked, has been applied to it and the ſecond. —— The Situation of the firſt is ſuch, that the flat Sides are ſuperior and inferior, while the Edges are anterior and poſterior, or nearly ſo; therefore ſufficient Space is left above it for the Subclavian Veſſels and Muſcle; and the broad concave Surface of it is oppoſed to the Lungs: But then in conſequence of this Situation, the Channel for the intercoſtal Veſſels is not to be found, and the Edges are differently formed from all the other, except the ſecond, the lower one being rounded, and the other

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(*a*) De articulo.

(*b*) Lib. 15. cap. 11.

ther ſharp.—— The Head of this Rib is not divided into two plain Surfaces by a middle Ridge, becauſe it is only articulated with the firſt *Vertebra* of the *Thorax*.—— The Cartilage at its anterior Extremity is oſſified in Adults, and is united to the *Sternum* at right Angles.—— Frequently this firſt Rib has a Ridge riſing near the Middle of its poſterior Edge, where one of the Heads of the *Scalenus* Muſcle riſes ;—— Nearer to the anterior Extremity, it is flatted, or ſometimes depreſſed by the Clavicle.

The *third* and *fourth* Ribs have been diſtinguiſhed by the Name of στέρεαι, *Solidæ* ; the fifth and ſixth, by the Appellation of στερνίτιδες, *Pectorales* ; the ſeventh and eighth are called παρασύραι, *Diſtractæ* †. But it muſt be acknowledged there is no great Occaſion or good Reaſon for theſe Names, ſince theſe Ribs ſcarce can claim any Thing, but what comes under the general Deſcription, or belongs to more than two of them.

The fifth, ſixth, and ſeventh, or rather the ſixth, ſeventh, eighth, and ſometimes fifth, ſixth, ſeventh, eighth, ninth Ribs have their Cartilages at leaſt contiguous ; and frequently they are joined to each other by croſs Cartilages ; and moſt commonly the Cartilages of the eighth, ninth, tenth are connected to the former, and to each other by firm Ligaments.

The *eleventh*, and ſometimes the *tenth* Rib has no Tubercle for its Articulation with the tranſverſe Proceſs of the *Vertebra*, to which it is only looſely fixed by a Ligament.—— The *Foſſa*

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† Laurent. Hiſt. Anat. Lib. 2. cap. 29. Paaw de oſſib. Part. 3. cap. 2.

*Foſſa* in its lower Edge, is not ſo deep as in the ſuperior Ribs, becauſe the Veſſels run more towards the Interſtice between the Ribs.—Its anterior Extremity is ſmaller than its Body, and its ſhort ſmall Cartilage is but looſely connected to the Cartilage of the Rib above.

The *twelfth* Rib is the ſhorteſt and ſtreighteſt. —Its Head is only articulated with the laſt *Vertebra* of the *Thorax*, therefore is not divided into two Surfaces.— This Rib is not joined to the tranſverſe Proceſs of the *Vertebra*, and therefore has no Tubercle, being often pulled neceſſarily inwards by the Diaphragm, which an Articulation with the tranſverſe Proceſs would not have allowed.— The *Foſſa* is not found at its under Edge, becauſe the Veſſels run below it.—— The anterior Extremity of this laſt Rib is ſmaller than its Middle, and has only a very ſmall pointed Cartilage fixed to it.—— To the whole Length of this Rib internally the Diaphragm is connected.

The Motion and Uſes of the Ribs ſhall be more particularly treated of, after the Deſcription of the *Sternum*.

The Ribs are all complete in a new-born Child, only their Cartilages are proportionally longer than in an adult Perſon.

Here I cannot help remarking the wiſe Providence of our Creator, in preſerving us from periſhing as ſoon as we come into the World. The Extremities by which the Bones of the Limbs are articulated remain in a cartilaginous State after Birth, and are many Years before they are entirely united to the main Body of their ſeveral Bones; whereas the Condyles of the occipital Bone, and of the lower Jaw, and the Heads and Tubercles of the Ribs, are true original Proceſſes, and oſſified before Birth; and therefore the Weight of the large Head is firmly ſupported, the Actions of Sucking, Swallowing, Reſpiration, *&c.* which are indiſpenſably neceſſary for us as ſoon as we come into the World, are performed without any Danger of ſeparating the Parts of the Bones that are moſt preſſed on in theſe Motions; whereas, had theſe Proceſſes of the Head, Jaw, and Ribs, been Epiphyſes at Birth, Children muſt have been expoſed to imminent Danger of dying by ſuch a Separation, the immediate Conſequences of which would be the Compreſſion of the Beginning of the *Medulla ſpinalis*, or Want of Food, or a Stop put to Reſpiration.

The *STERNUM* †, or Breaſt-bone is the broad flat Bone, or Pile of Bones at the Forepart of the *Thorax*.——The Number of Bones, which this ſhould be divided into, has occaſioned Debates among Anatomiſts, who have conſidered it in Subjects of different Ages.—— In Adults of a middle Age, it is compoſed of three Bones, which eaſily ſeparate after the Cartilages connecting them are deſtroyed: Frequently the two lower Bones are found intimately united, and very often in old People, the *Sternum* is a continued bony Subſtance from one End to the other, though we may ſtill obſerve two, ſometimes three tranſverſe Lines on its Surface, which are Marks of the former Diviſions.

When we conſider the *Sternum* as one Bone, we find it broadeſt and thickeſt above, and becoming ſmaller as it deſcends. The internal or poſterior Surface of this Bone is ſomewhat hollowed for enlarging the *Thorax*, but the Convexity on the external Surface, is not ſo conſpicuous, becauſe the Sides are preſſed outwards by the true Ribs, the round Heads of whoſe Cartilages are received into ſeven ſmooth Pits formed in each Side of the *Sternum*, and are kept firm there by ſtrong Ligaments, which on the external Surface have a particular radiated Texture (*a*).--Frequently the cartilaginous Fibres thruſt themſelves into the bony Subſtance of the *Sternum*, and are joined by a Sort of Suture.—— The Pits at the upper Part of the *Sternum*, are at the greateſt Diſtance one from another, and as they deſcend are nearer, ſo that the two loweſt are contiguous.

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† Στῆθος, Os Pectoris, enſiforme, ſcutum cordis.

The Subſtance of the Breaſt-Bone is cellular, with a very thin external Plate, eſpecially on its internal Surface, where, with *Jac. Sylvius* (*b*) we may frequently obſerve rather a cartilaginous Cruſt ſpread over it. On both Surfaces however, a ſtrong ligamentous Membrane is cloſely braced, and the Cells of this Bone are ſo ſmall, that a conſiderable Quantity of oſſeous Fibres muſt be employed in the Compoſition of it: Whence, with the Defence which the Muſcles give it, and the moveable Support it has from the Cartilages, it is ſufficiently ſecured from being broken by any ſmall external Force; For it is ſtrong by its Quantity of Bone; its Parts are kept together by the Ligaments, and it yields enough to elude conſiderably the Violence offered.

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(*a*) Ruyſch Catalog. Rar. Fig. 9.
(*a*) In Galen. de oſſibus, cap. 12.

So far in general may be ſaid of this Bone; but to deſcend to its particular Deſcription, let us examine the three Bones, of which, according to the common Accounts, it is compoſed in Adults.

The *firſt*, all agree is ſomewhat of the Figure of a Heart, as it is commonly painted, only it does not terminate in a ſharp Point.— This is the uppermoſt thickeſt Part of the *Sternum*.

The ſuperior Middle Part of this firſt Bone, where it is thickeſt, is hollowed, to make Place for the *Trachea arteria*, though this Cavity † is principally formed by the Bone being raiſed on each Side of it, partly by the Clavicles thruſting it inwards, and partly by the *Sterno-maſtoidei* Muſcles pulling it upwards.—— On the Outſide of each Tubercle, there is an oblong Cavity, that, in viewing it tranſverſely from before backwards, appears a little convex: Into theſe *Glenæ* the Extremities of the Clavicles are received.— Immediately below theſe, the Sides of this Bone begin to turn thinner, and in each a ſuperficial Cavity or a rough Surface is to be ſeen, where the firſt Ribs are received or joined to the *Sternum*.—— In the Side of the under Extremity of this firſt Bone, the half of the Pit for the ſecond Rib on each Side is formed.—— The upper Part of the poſterior Surface is covered with a ſtrong Ligament deſcribed by *Winſlow* (*a*) and *Weitbreicht* (*b*) which ſecures the Clavicles, and is afterwards to be more particularly taken notice of.

The ſecond or middle Diviſion of this Bone, is much longer, narrower, and thinner than the firſt; but,excepting that it is a little narrower above than below, it is nearly equal all over in its Dimenſions of Breadth or Thickneſs.— In the Sides of it are complete Pits for the third, fourth, fifth and ſixth Ribs, and an half of the Pits for the ſecond and ſeventh.—— Near its Middle an unoſſified Part of the Bone is ſometimes found, which freed of the ligamentous Membrane or Cartilage that fills it, is deſcribed as an Hole; and in this Place,for the moſt Part, we may obſerve a tranſverſe Line, which has made Authors divide this Bone into two.—— When the Cartilage between this and the firſt Bone is not oſſified, a manifeſt Motion of this upon the firſt may be obſerved in Reſpiration, or in raiſing the *Sternum*, by pulling the Ribs upwards in a recent Subject.

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† Σφαγὴ, Jugulum, Furcula ſuperior.

(*a*) Act. Petropolit. Tom. iv. p. 255.

(*b*) Des Os frais, Sect. 248.

The third Bone is by much leſs than the other two,and has only one half of the Pit for the ſeventh Rib formed in it; wherefore it might be reckoned only an *Appendix* of the *Sternum*.—— In young Subjects it is always cartilaginous,and is better known by the Name of *Cartilago xiphoides* or *enſiformis* †, than any other, though the Ancients often called the whole *Sternum*, *Enſiforme*, comparing the two firſt Bones to the Handle, and this *Appendix* to the Blade of a Sword.—— This third Bone is ſeldom of the ſame Figure, Magnitude or Situation in any two Subjects; for ſometimes it is a plain triangular Bone, with one of the Angles below, and perpendicular to the middle of the ſuperior

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† Clypealis, gladialis, mucronata, malum granatum, ſcutum ſtomachi, epiglottalis, cultralis, Medium Furculæ inferioris, ſcutiformis, enſiculata.

Side, by which it is connected to the ſecond Bone.—— In other People the Point is turned to one Side, or obliquely forwards or backwards.—— Frequently it is all nearly an equal Breadth, and in ſeveral Subjects, the Extremity of it is bifurcated; Whence ſome Writers give it the Name of *Furcella* or *Furcula inferior*; or elſe it is perforated in the Middle.—— In the greateſt Number of Adults it is oſſified, and tipped with a Cartilage; in ſome one half of it is cartilaginous, and in others it is all in a cartilaginous State.

So many different Ways this ſmall Bone may be formed, without any Inconvenience: But then ſome of theſe Poſitions may be ſo directed, as to bring on a great Train of ill Conſequences; particularly, when the lower Extremity is entirely oſſified, and is too much turned outwards or inwards, or when the Conjunction of this *Appendix* with the ſecond Bone is too weak. *Rolfincius* (*a*) relates the Hiſtory of an old Man, who could not bend his Body forwards, without a violent pungent Pain from the Oſſification and ſharp Point of this Bone. *Paaw* (*b*) aſſures us, he has ſeen ſeveral Inſtances of a difficult Breathing from the ſame Cauſe, and enumerates ſeveral Diſeaſes, ſuch as *Pthiſis pulmonalis*, *Obſtructions of the Spleen*, *Liver*, or *Meſentery*, which may depend on too great a Relaxation of this Cartilage; and ſometimes this Relaxation may only be a Conſequence of theſe Diſeaſes. *Borrichius* (*c*) confirms all this by ſome Examples. But not to be tedious in

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(*a*) Diſſert. Anat. lib. 2. cap. 41.
(*b*) De Oſſibus, part 1. cap. 3. & part. 3. cap. 3.
(*c*) Act. Haſn. Vol. 5. Obſ. 79.

in relating ſuch Hiſtories, I ſhall refer you to *Bonetus (a)*, who has ſeveral Examples collected, and will direct you to the Writers on this Subject, which in the laſt Century employed ſeveral Pens, though it is now much neglected, notwithſtanding that the Connexion of the Diaphragm to this Bone, the Situation of the large Lobe of the Liver and of the Stomach, and the conſtant Preſſure and rubbing of our Cloaths on this Part, lead us naturally to conſider the Effects of its faulty Structure and Situation.

The *Sternum* is joined by *Synchondroſis* to the ſeven upper Ribs, unleſs when the firſt coaleſces with it in an intimate Union of Subſtance; and it is articulated with each of the *Clavicles* by a *Ginglymus* of the ſecond kind.

The *Sternum* moſt frequently has four round ſmall Bones, ſurrounded with Cartilage, in Children born at the full Time; the uppermoſt of theſe, which is the firſt Bone, being the largeſt.—— Two or three other very ſmall bony Points are likewiſe to be ſeen in ſeveral Children.—— The Number of Bones increaſes for ſome Years, and then diminiſhes, but uncertainly, till they are at laſt united into thoſe above deſcribed of an Adult.

The Uſes of this Bone are, to afford Origin and Inſertion to ſeveral Muſcles; to ſuſtain the *Mediaſtinum*; to defend the vital Organs, the Heart and Lungs at the Fore part; and, laſtly, by ſerving as a moveable *Fulcrum* of the Ribs, to aſſiſt conſiderably in Reſpiration:

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(*d*) Sepulchret. Anat. tom. 2. lib. 3. Sect. 5. Append. ad obſerv. 8. & ibid. Sect. 7. Obſ. 19.

Which Action, ſo far is it depends on the Motion of the Bones, we are now at Liberty to explain.

When the Ribs that are connected by their Cartilages to the *Sternum*, or to the Cartilages of the true Ribs, are acted upon by the intercoſtal Muſcles, they muſt all be pulled from the oblique Poſition which their Cartilages kept them in, nearer to right Angles with the *Vertebræ* and *Sternum*, becauſe the firſt or uppermoſt Rib is by much the moſt fixed of any; and their large arched middle Part, as was remarked in the Deſcription of the Ribs, are turned outwards, to widen the Cavity of the *Thorax*; while by raiſing the Ribs nearer to right Angles, the Diſtance between the parallel Lines that comprehend their Extremities is increaſed; And as the *Vertebræ* hinder the Ribs to recede back, this whole Increaſe muſt be by the Advance of theſe Extremities forwards.--- Hence the *Sternum*, the intermediate *Fulcrum*, preſſed ſtrongly on both Sides, muſt be puſhed forwards, and that, at its ſeveral Parts, in proportion to the Length and Motion of its Supporters the Ribs; that is, moſt at its lower Extremity; which, thus forced forwards with the Cartilages now in the ſame Manner acted upon, muſt draw the *Diaphragm* connected to them; conſequently ſo far ſtretch it, and bring it nearer to a Plain.——— And the ſame Power that raiſes this Bone and Cartilages, ſufficiently fixes them, ſo as they reſiſt the Action of that Muſcle, whoſe Fibres contract at the ſame time, and thruſt the *Viſcera* of the *Abdomen* downwards.——— The arched Part of the Ribs being thus moved outwards, the anterior Extremity of the Ribs and the *Sternum* being advanced forwards, and the Diaphragm being brought nearer to a plain Surface, inſtead of being greatly convex on each Side within each Cavity of the *Thorax*, 'tis evident how conſiderably the Cavity, of which the nine or ten upper Ribs are the Sides, muſt be widned, and made deeper and longer.—— While this is doing in the ſuperior Ribs, the lower ones, whoſe Cartilages are not joined to the *Sternum* or other Cartilages, perform a very different Office, though they conſpire to the ſame Intention, the Enlargement of the *Thorax*: For having no fixed Point to which their anterior Extremities are faſtned, and the *Diaphragm* being inſerted into them at the Place where it runs pretty ſtreight upwards from its Origin at the *Vertebræ*, theſe Ribs are drawn downwards by this ſtrong Muſcle, and by the Muſcles of the *Abdomen*, which at this Time are reſiſting the ſtretching Force of the Bowels; while the intercoſtal Muſcles are pulling them in the contrary Direction, to wit, upwards: The Effect therefore of either of theſe Powers, which are Antagoniſts to each other, is very little as to moving the Ribs either up or down; but the Muſcles of the *Abdomen* puſhed at this Time outwards by the *Viſcera*, carry theſe Ribs along with them. Thus the *Thorax* is not only not allowed to be ſhortned, but is really widned at its lower Part, to aſſiſt in making ſufficient Space for the due Diſtenſion of the Lungs.

As ſoon as the Action of theſe ſeveral Muſcles ceaſes, the elaſtic Cartilages extending themſelves to their natural Situation, depreſs the upper Ribs, and the *Sternum* ſubſides;——the *Diaphragm* is thruſt up by the *Viſcera abdominalia*, and raiſes the lower Ribs with it, in which it is aſſiſted by what Action their intercoſtal Muſcles have; while the oblique and tranſverſe Muſcles of the Belly ſerve to draw theſe Ribs inwards at the ſame Time.——By theſe Cauſes the Cavity of the Breaſt is diminiſhed in all its Dimenſions.

## *Of the ſuperior Extremities.*

AUthors are much divided in their Opinions about the Number of Bones which each *ſuperior Extremity* * ſhould be ſaid to conſiſt of, ſome deſcribing the *Clavicle* and *Scapula* as Part of it, others claſſing theſe two Bones with thoſe of the *Thorax*: But ſince moſt Quadrupeds have no *Clavicles*, and the human *Thorax* can perform its Functions right when the *Scapula* is taken away (*a*); whereas it is impoſſible for us to have the right Uſe of our Arms without theſe Bones, I muſt think that they belong to the ſuperior Extremities, and therefore ſhall divide each of them into the *Shoulder*, *Arm*, *Fore-arm* and *Hand*.

The *SHOULDER* conſiſts of the *Clavicle* and *Scapula*.

*CLAVICULA*, or Collar-bone *, is the long crooked Bone, in Figure like an *Italic ſ*, placed

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† Κῶλα, γυῖα, ἐκφύαδες. Enata, adnata, explantata membra, artus.

(*a*) Philoſoph. Tranſact. Num. 449. Sect. V.

† Os jugulare, jugulum, furcula, ligula, clavis, humerus quibuſdam.

ced almoſt horizontally between the upper lateral Part of the *Sternum*, and what is commonly called the Top of the Shoulder, which as a *Clavis* or Beam it bears off from the Trunk of the Body.

The *Clavicle*, as well as other long round Bones, is larger at its two Ends than in the Middle. The End next to the *Sternum* * is triangular: The Sides conſtituting the poſterior Angle are conſiderably produced, to form a ſharp Ridge, to which the tranſverſe Ligament extended from one Clavicle to the other, is fixed.——The Side oppoſite to this is ſomewhat rounded.—— The Middle of this protuberant Extremity is as irregularly hollowed as the Cavity in the *Sternum* for receiving it is raiſed; but in a recent Subject, the irregular Concavities of both, are ſupplied by a moveable Cartilage, which is much more cloſely connected by Ligaments to the Circumference of the Articulation, than thoſe of the lower Jaw are.

From this internal End, the *Clavicle*, for about two Fifths of its length, is bended obliquely forwards and downwards. On the upper and Fore-part of this Curvature a ſmall Ridge is ſeen, with a plain rough Surface before it; whence the *Muſculus ſterno-hyoideus* and *ſterno-maſtoideus* have in Part their Origin.— Near the inferior Angle a ſmall plain Surface is often to be remarked, where the firſt Rib and this Bone, according to *Dionis*'s (*a*) Obſervation, are contiguous.— From this a rough plain Surface is extended along this anterior Convexity, where the pectoral Muſcle has Part of its Origin:— Behind, the Bone is made flat and rough, by the Inſertion of the larger Share of the Subclavian Muſcle.— After the Clavicle begins to form the poſterior Convexity, it is round, but ſoon after becomes broad and thin; which Shape it retains to its external End.—— Along the external Concavity a rough Sinuoſity runs, from which ſome Part of the deltoid Muſcle takes its Riſe:—— Oppoſite to this, on the convex Edge, a ſcabrous Ridge gives Inſertion to a Share of the *cucullaris* Muſcle. The upper Surface of the Clavicle here is flat; but the lower is hollow, for lodging the Beginning of the *Muſculus ſubclavius*, and a ſtrong Ligament.

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* Παρασφάγις.

(*a*) Sixieme demonſtr. des Os.

The external End † of this Bone is horizontally oblong, ſmooth, ſloping at the poſterior Side, and tipped in a recent Subject with a Cartilage for its Articulation with the *Acromion ſcapulæ*.——Round this the Bone is ſpungy for the firmer Connexion of the Ligaments; and near this End a little rough Tubercle appears on the convex back Part, from which a ſtrong Ligament goes to the coracoid Proceſs of the *Scapula*.

The medullary Arteries, having their Direction obliquely outwards, enter the Clavicles by one or more ſmall Paſſages in the middle of the poſterior Surface.

The Subſtance of this Bone is the ſame as of the other round long Bones.

It is joined to the *Sternum* by what I called the ſecond Species of *Ginglymus*, there being

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† Ἐπωμὶς.

Protuberances and Depreſſions of the two Bones that form this moveable Joint.——The Ligaments, which ſurround this Articulation to ſecure it, are ſo ſhort and ſtrong, that little Motion can be allowed any Way; and a ſtrong Ligament that is ſtretched a-croſs the upper *Furcula* of the *Sternum* from the poſterior prominent Angle of one Clavicle to the ſame Place of the other Clavicle, ſerves to keep each of theſe Bones more firmly in their Place.—— By the Aſſiſtance however of the moveable intervening Cartilage, the Clavicle can at this Joint be raiſed or depreſſed, and moved backwards and forwards ſo much, as that the exterior End, conſidering its Diſtance from that Axis, ſhall enjoy very conſpicuous Motions. ——The Articulation of the exterior End of the Clavicle ſhall be conſidered after the Deſcription of the *Scapula*.

The Clavicles of Infants are not deficient in any of their Parts, nor have they any Epiphyſes at their Extremities joined afterwards to their Bodies, as moſt other ſuch long Bones have, which preſerves them from being bended too much, and from the Danger of any unoſſified Parts being ſeparated by the Force which pulls the Arms forwards.

The Uſes of the Clavicles are, to keep the *Scapulæ*, and conſequently all the ſuperior Extremities, from falling in and forward upon the *Thorax*; by which, as in moſt Quadrupeds, the Motions of the Arms would be much confined, and the Breaſt made too narrow.—— The Clavicles likewiſe afford Origin to ſeveral Muſcles, and a Defence to large Veſſels.

*SCAPULA*, or Shoulder-blade [†], is the triangular Bone ſituated on the Outſide of the Ribs, and extended, when we are in the moſt natural and leaſt ſtraining Poſture, from the ſecond to the ſeventh true Rib, with its ſuperior poſterior Angle about three Inches from the ſpinal Proceſſes of the *Vertebræ*.——The long Side between that Angle and the inferior one is ſtretched obliquely forwards as it deſcends, having nothing between it and the Ribs, except the thin Extremities of ſome Muſcles; but as the *Scapula* advances forwards to its Articulation with the Arm-bone, its Diſtance from the Ribs increaſes.

The Sides and Angles of the *Scapula* are all unequal; for the poſterior Side or the Baſe is the longeſt, the inferior *Coſta* is the ſecond in Length, and the ſuperior *Coſta* is about as much proportionally ſhorter than the inferior, as this is ſhorter than the Baſe.——The inferior Angle is very acute, the ſuperior is near to a right Angle; and what is called the anterior does not deſerve the Name, for the two Sides do not meet to form an Angle.——The Body of this Bone is concave towards the Ribs, and convex behind, where it has the Name of *Dorſum* [‡].——Three Proceſſes are generally reckoned to proceed from the *Scapula*.——The firſt is the large Spine that riſes from its convex Surface behind, and divides it unequally.—The ſecond Proceſs ſtands out from the Fore-part of the ſuperior *Coſta*, and from its imaginary Reſemblance of a Crow's Beak is named *Coracoides* ‡.——The third Proceſs is the whole anterior thick bulbous Part of the Bone.

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[†] Ὠμοπλάτος, ἐπινώτιον, Latitudo humeri, ſcoptulum vel ſcutulum opertum, ſpatula, ala, humerus, clypeus, ſcutum thoracis.

[‡] Χελύνιον.

After thus naming the ſeveral conſtituent Parts of the *Scapula*, the particular Deſcription will be more eaſily underſtood.

The *Baſe*, which is tipped with Cartilage in a young Subject, is not all ſtreight: For above the Spine, this Side runs obliquely forwards to the ſuperior Angle; in which oblique Space the *Muſculus patientiæ* is inſerted.——At the Root of the Spine, on the Back-part of the Baſe, a triangular plain Surface is formed by the lower Fibres of the *Trapezius*.——Below this the poſterior Edge of the *Scapula* is ſcabrous and rough for the Inſertion of the *Serratus major anticus* and rhomboid Muſcles.

The inferior Angle is made ſmooth on its poſterior Surface, by the *latiſſimus dorſi* paſſing over it.——From this forwards the inferior *Coſta* is for ſome Way brought to a more direct Courſe, by the Action of that ſame Muſcle, and ſo far the poſterior Surface is flatted by the Origin of the *Teres major*.——As this inferior *Coſta* runs forward from this, it is of a conſiderable Thickneſs, is ſlightly hollowed, and made ſmooth by the *Teres minor*, on its poſterior Surface, while it has a *Foſſa* formed into it below by Part of the *ſubſcapularis*; and between the two a Ridge with a ſmall Depreſſion appears, where the *longus extenſor Cubiti* has its Origin.

The ſuperior *Coſta* is very thin, and near its Fore-part has a ſemilunar Cavity formed in it;

croſs

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‡ Anchoroides, ſigmoides, digitalis, anciſtroides.

croſs the Extremities of which a ſtrong Ligament is ſtretched, and ſometimes the Bone is continued, to form an Hole for the Paſſage of Blood-Veſſels and Nerves.——Immediately behind this *Cavitas ſemilunata*, the *Muſculus coraco-hyoideus* has its Riſe; and from it to the Termination of the *Foſſa* for the *Teres minor*, the *Scapula* is narrower than any where elſe, and ſupports the third Proceſs. This Part has got the Name of *Cervix*.

The whole *Dorſum* of the *Scapula* is always ſaid to be convex; but by reaſon of the raiſed Edges that ſurround it, it is divided into two Cavities by the Spine, which is ſtretched from behind forwards, much nearer to the ſuperior *Coſta* than to the inferior.——The *Cavitas ſupraſpinata* is really concave where the Muſcle of the ſame Name is lodged; while the Surface of this Bone below the Spine is convex, except a *Foſſa* that runs at the Side of the inferior *Coſta*; and on this Surface the *Muſculus infra-ſpinatus* is placed.

The internal or anterior Surface of this Bone is hollow, except in the Part above the Spine which is convex.——In the Hollow the *ſubſcapularis* Muſcle is contained, and forms ſeveral Ridges and intermediate Depreſſions, commonly miſtaken for Prints of the Ribs, they point out the Interſtices of the Bundles of Fibres of which the *ſubſcapularis* Muſcle is compoſed, as *Winſlow (a)* juſtly obſerves.

The Spine † riſes ſmall at the Baſe of the *Scapula*, and becomes higher and broader as it ad-

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(*a*) Memoires de l'Acad. des Sciences, 1722.

† Ῥάχις, ὑπεροχὴ ὠμοπλατῶν, Eminentia ſcapularum.

advances forwards.——On the Sides it is unequally hollowed and crooked by the Actions of the adjacent Muſcles.——Its Ridge [†] is divided into two rough flat Surfaces: Into the ſuperior the *Trapezius* Muſcle is inſerted; and from the inferior, Part of the *Deltoid* has its Origin.——The Extremity of the Spine becomes very broad and flat, and is well known by the Name of the *Acromion* [‡] or Top of the Shoulder. This is an *Epiphyſe* in Children; and in ſome old Subjects I have ſeen it only joined by a Cartilage to the Spine.——The interior Edge of the *Acromion* is flat, ſmooth, and covered with a Cartilage, for its Articulation with the external End of the Clavicle; and it is hollowed below to allow a Paſſage to the *infra-* and *ſupra-ſpinati* Muſcles, and free Motion to the *Os humeri*.

The coracoid [†] Proceſs is a little crooked, with its Point inclining forwards; ſo that a Hollow is left at the lower Side of its Root, for the Paſſage of the *infra-ſcapularis* Muſcle.——The Extremity of this Proceſs is marked with three plain Surfaces: Into the internal, the *Serratus minor anticus* is inſerted: From the external, one Head of the *Biceps flexor cubiti* riſes; and from the lower one, the *Coraco-brachialis* has its Origin.——At the Upper-part of the Root of this Proceſs, immediately before the *Cavitas ſemilunaris*, a ſmooth Tubercle appears where a Ligament from the *Clavicle* is

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[†] Pterygium, criſta.

[‡] Ἐπωμὶς, ἀγκυροειδὴς, κορακοειδὴς, κατακλεῖς. Acromii os, ſummus armus, roſtrum porcinum, proceſſus digitalis.

[†] Ἀγκυροειδὴς, σιγμοειδὴς, Roſtriformis.

fixed. From all the external Side of this coracoid *Apophyſe*, a broad Ligament goes out, which ſoon becoming narrow is fixed to the *Acromion*.

From the *Cervix ſcapulæ* the third Proceſs is produced. The Fore-part of this is formed into a *Glenoid* Cavity [‡], which is of the Shape of the longitudinal Section of an Egg, having an obtuſe Extremity below, and an acute one above.——Between the poſterior Brims of this Hollow and the anterior Root of the Spine a large Sinuoſity is left, for the Tranſmiſſion of the *ſupra-* and *infra-ſpinati* Muſcles; and on the Upper-part of theſe Brims we may remark a ſmooth Surface, where the ſecond Head of the *Biceps flexor cubiti* has its Origin.——The Root of the *Supercilia* is rough all round, for the firmer Adheſion of the circular Ligament of the Articulation, and of the Cartilage which is placed on theſe Brims, where it is very thick, but becomes very thin as it is continued towards the Middle of the Cavity, which it lines all over.

The medullary Veſſels enter the *Scapula* near the Baſe of the Spine.

The Subſtance of the *Scapula* is, as in all other broad flat Bones, cellular, but of a very unequal Thickneſs; for the Neck and third Proceſs are very thick and ſtrong; the inferior *Coſta*, Spine and coracoid Proceſs, are of a middle Thickneſs; and the Body is ſo preſſed by the Muſcles as to become very thin and diaphanous.

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[‡] Ὠμοκότυλις.

The *Scapula* and Clavicle are joined by plain Surfaces, tipped with Cartilage †, to which Sort of Articulation I applied the technical Name *Arthrodia*, by which neither Bone is allowed any conſiderable Motion, being tightly tied down by the common circular Ligament, and by a very ſtrong one which proceeds from the coracoid Proceſs, but divides into two before it is fixed into the *Clavicle*, with ſuch a Direction, as either can allow this Bone to have a ſmall Rotation, in which its poſterior Edge turns more backwards, while the anterior one riſes farther forwards; or it can yeild to the Fore-part of the *Scapula* moving downwards, while the Back-part of it is drawn upwards; in both which Caſes the oblong ſmooth articulated Surfaces of the *Clavicle* and *Scapula* are not in the ſame Plane, but ſtand a little tranſverſely or acroſs each other, and thereby preſerve this Joint from Luxations, to which it would be ſubject, if either of the Bones was to move perpendicularly up and down without any Rotation.——Sometimes a moveable ligamentous Cartilage is found in this Joint, otherwhiles ſuch a Cartilage is only interpoſed at the anterior Half of it, and in ſome old Subjects I have found a ſeſamoid Bone here, as *Sylvius (a)* did.——The *Scapula* is connected by *Syſarcoſis* to the Head, *Os hyoides*, *Vertebræ*, Ribs and Arm-bone; and by Means of the Muſcles, that have one End faſtned to theſe Bones, and the other to the *Scapula*, it is moved upwards, downwards,

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† Acromion, κατακλεῖς, Clauſuræ.

(a) Iſagog. Anat. Lib. 1. Cap. 2.

backwards or forwards, and can turn in its own Plain, carrying always the outer End of the Clavicle and the Arm along with it (a).—— The *glenoid* Cavity of this Bone receives the *Os humeri* by *Enarthroſis*; of which more hereafter.

The Uſe of the *Scapula* is to ſerve as a *Fulcrum* to the Arm; and, by altering its Poſition on different Occaſions, to allow always the Head of the *Os humeri* a right ſituated Socket to move in, and thereby to aſſiſt and to enlarge greatly the Motions of the *ſuperior Extremity*, and to afford the Muſcles which riſe from it more advantageous Actions, by altering their Directions to the Bone which they are to move.—— This Bone alſo ſerves to defend the Back-part of the *Thorax*, and is often employed to ſuſtain Weights or to reſiſt Forces too great for the Arm to bear.

The Baſe, *Acromion*, coracoid Proceſs and Head of the *Scapula*, are all in a cartilaginous State at the Birth; and the three firſt are joined as *Epiphyſes*; while the Head, with the *glenoid* Cavity, is not formed into a diſtinct ſeparate Bone, but is gradually produced by the Oſſification of the Body of this Bone being continued forwards.

The *ARM* has only one Bone, beſt known by the *Latin* Name of *OS HUMERI* [†]; which is long, round, and nearly ſtreight.

The upper End of this Bone [†] is formed into a large round ſmooth Head, whoſe middle

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(a) See Winſlow. Memoires de l'Acad. des Sciences 1726.

[†] Ἀκροκολία, *ὠλένη*, Os brachii, armi, adjutorium, parvum brachium, canna brachii.

Point is not in a ſtreight Line with the Axis of the Bone, but ſtands obliquely backwards from it.——The Extent of the Head is diſtinguiſhed by a circular *Foſſa* ſurrounding its Baſe, where this Head is united to the Bone, and from which the circular Ligament of the Joint riſes.——Below the Fore-part of its Baſe two Tubercles ſtand out: The ſmalleſt one, which is ſituated moſt to the Inſide, has the Tendon of the *ſubſcapularis* Muſcle inſerted into it.—— The larger more external Protuberance is divided at its upper Part into three ſmooth plain Surfaces: Into the anterior of which, the *Muſculus ſupra-ſpinatus*; into the middle or largeſt, the *infra-ſpinatus*; into the poſterior, the *Teres minor* is inſerted.——Between theſe two Tubercles, exactly in the Fore-part of the Bone, a deep long *Foſſa* is formed for lodging the tendinous Head of the *Biceps flexor cubiti*; which, after paſſing, in a Manner peculiar to itſelf, through the Cavity of the Articulation, is tied down by a tendinous Sheath extended a-croſs the *Foſſa*; in which, and in the neighbouring Tubercles, are ſeveral remarkable Holes, which are penetrated by the tendinous and ligamentous Fibres, and by Veſſels.—— On each Side of this *Foſſa*, as it deſcends in the *Os humeri*, a rough Ridge, gently flatted in the Middle, runs from the Roots of the Tubercles.— Into the interior the *latiſſimus Dorſi*, *Teres major* and *Coraco-brachialis* are inſerted; and into the anterior, the *Pectoralis* terminates.—————From the Back-part of the Root of the largeſt Tubercle, ſuch a Ridge alſo is continued, from

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(†) Acrocolium.

from which the *Brevis extenſor cubiti* riſes.—— This Bone is flatted on the Inſide about its Middle, by the Belly of the *Biceps flexor cubiti.*——In the Middle of this plain Surface the Entry of the medullary Artery is ſeen ſlanting obliquely downwards.——At the Fore-ſide of this Plain the Bone riſes in a Sort of Ridge, which is rough, and often has a great many ſmall Holes in it, where the Tendon of the ſtrong *Deltoid* Muſcle is inſerted, on each Side of which the Bone is ſmooth and flat, where the *Brachiæus internus* riſes. The exterior of theſe two flat Surface is the largeſt; behind it a ſuperficial ſpiral Channel formed by the *Muſcular* Nerve, runs from behind forwards and downwards.— The poſterior Surface of the Body of the *Os humeri* is flatted by the Extenſors of the Fore-arm. Near the lower End of this Bone, a large ſharp Ridge is extended on the Out-ſide between the anterior and poſterior Surfaces: From it the *Muſculus ſupinator radii longus*, and the longeſt Head of the *Extenſor carpi radialis* riſe.——Oppoſite to this, there is another ſmall Ridge, from a little Depreſſion on the Foreſide of which the *Pronator radii teres* riſes.

The Body of this Bone becomes gradually broader towards the lower End, where it has ſeveral Proceſſes; both at the Fore and Backpart of their Roots there is a Cavity †. The anterior is divided by a Ridge into two; the external, which is the leaſt, receives the End of the *Radius*; and the Internal receives the *Coronoid* Proceſs of the *Ulna* in the Flexions of the Fore-arm, while the poſterior deep triangular Cavity lodges the *Olecranon* in the Extenſions of that Member.——The Bone betwixt theſe two Cavities is preſſed ſo thin, by the Proceſſes of the *Ulna*, as to appear diaphanous in ſeveral Subjects.——The Sides of the poſterior Cavity are ſtretched out into two Proceſſes, one on each Side, theſe are called *Condyles*, from each of which a ſtrong Ligament goes out to the Bones of the *Fore-arm*.——The external *Condyle*, which, as *Winſlow* (a) obſerves, has an oblique Direction alſo forwards in reſpect of the internal, when the Arm is in the moſt natural Poſture, is equally broad, and has an obtuſe ſmooth Head riſing from it forwards. ——From the rough Part of the *Condyle* the inferior Head of the *Bicornis*, the *Extenſor digitorum communis*, *Extenſor carpi ulnaris*, and ſome Part of the *Supinator radii brevis* take their Riſe; and on the ſmooth Head the upper End of the *Radius* plays.——Immediately on the Outſide of this there is a Sinuoſity for the Paſſage of the *Muſcular* Nerve.——The internal *Condyle* is more pointed and protuberant than the external, to give Origin to ſome Part of the *Flexor carpi radialis*, *Pronator radii teres*, *Palmaris longus*, *Flexor digitorum ſublimis*, and *Flexor carpi ulnaris*.—— Between the two *Condyles*, is the *Trochlea* or Pulley, which conſiſts of two lateral Protuberances and a middle Cavity that are ſmooth and covered with Cartilage.——When the Fore-arm is extended, the Tendon of the internal *Brachiæus* Muſcle is lodged in the Fore-part of the Cavity of this Pulley.——The external Protuberance, which is

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† Βαθμίδες.

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(*a*) Memoires de l'Acad. des Sciences 1722.

is much the leaſt, has a ſharp Edge behind; but forwards, this Ridge is obtuſe, and only ſeparated from the little Head, already deſcribed, by a ſmall *Foſſa*, in which the joined Edges of the *Ulna* and *Radius* move.—— The internal Protuberance of the Pulley is largeſt and higheſt, and therefore in the Motions of the *Ulna* upon it, that Bone would be inclined outwards, was it not ſupported by the *Radius* on that Side.— Between this internal Protuberance and *Condyle*, a Sinuoſity may be remarked, where the *ulnar* Nerve paſſes.

The Subſtance, and the internal Structure of the *Os humeri* is the ſame, and diſpoſed in the ſame Way, as in other long Bones.

The round Head at the upper End of this Bone is articulated by *Enarthroſis*, with the *Glenoid* Cavity of the *Scapula*, which being ſuperficial, and having long Ligaments, allows the Arm a free and extenſive Motion.———Theſe Ligaments are however conſiderably ſtrong: For, beſides the common circular one, the Tendons of the Muſcles perform the Office, and have been deſcribed under the Name of Ligaments.—— Then the *Acromion* and *Coracoid* Proceſs, with the ſtrong broad Ligaments ſtretched betwixt them, ſecure the Articulation above, where the greateſt and moſt frequent Force is applied, to thruſt the Head of the Bone out of its Place. It is true, that there is not near ſo ſtrong a Defence at the inferior Part of the Articulation; but in the ordinary Poſtures of the Arm, that is, ſo long as it is at an acute Angle with the Trunk of the Body, there cannot be any Force applied at this Place to occaſion a

Luxation, ſince the Joint is protected ſo well above.

The Motions, which the Arm enjoys by this Articulation, are to every Side, and by the Succeſſion of theſe different Motions, a Circle may be deſcribed. Beſides which, the Bone performs a ſmall Rotation round its own *Axis*. But tho' this can be performed by the round Head in all Poſitions, yet as theſe vary, the Effects upon the Body of the Bone will be very different: For if the Middle of the Head is the Centre of Rotation, as it is when the Arm hangs down by the Side, the Body of the Bone will only be moved forwards and backwards; becauſe, as *Hippocrates* (a) has long ſince remarked, the *Axis* of Motion of the Head is near at right Angles with the Length of the Bone; whereas when the Arm is raiſed to right Angles with the Trunk of the Body, the Centre of Motion and the Axis of the Bone come to be in the ſame ſtreight Line, and therefore the Body of the *Os humeri* will perform the ſame Motion with its Head.——The lower End of the *Os humeri* is articulated with the Bones of the Fore-arm, and carries them with it in all its Motions, but ſerves as a Baſe on which they perform the Motions peculiar to themſelves, as ſhall be deſcribed afterwards.

Both the Ends of this Bone are cartilaginous in a new-born Infant, and the large Head with the two Tubercles, and the *Trochlea* with the two *Condyles*, become *Epiphyſes* before they are united to the Body of the Bone.

The *FORE-ARM* † conſiſts of two long

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(a) De Articulo.

† Cubitus, πῆχυς, ὠλένη, πυγὼν, Ulna, lacertus.

Bones, the *Ulna* and *Radius*; whoſe Situation, in reſpect of each other, is oblique in the leaſt ſtraining, or moſt natural Poſture; that is, the *Ulna* is not directly behind, nor on the Outſide of the *Radius*, but in a middle Situation between theſe two, and the *Radius* croſſes it.—— But the Situation of theſe two Bones, and of all the other Bones of the *ſuperior Extremity* that are not yet deſcribed, is frequently altered; and therefore, to ſhun explanatory Repetitions, I deſire it may be now remarked, that in the remaining Account of the *ſuperior Extremity*, I underſtand by the Term of *poſterior*, that Part which is in the ſame Direction with the Back of the Hand; by *anterior*, that anſwering to the Palm; by *internal*, that on the ſame Side with the Thumb; by *external*, the Side neareſt to the little Finger; ſuppoſing the Hand always to be in a middle Poſition between *Pronation* and *Supination*.

*ULNA* *, ſo named from its being uſed as a Meaſure, is the longeſt of the two Bones of the Fore-arm, and ſituated on the Out-ſide of the *Radius*.

At the upper End of the *Ulna* are two Proceſſes.——The poſterior is the largeſt, and formed like a Hook, whoſe concave Surface moves upon the Pulley of the *Os humeri*, and is called *Olecranon* ‡, or Top of the Cubit.—— The poſterior convex Part of it is rough and ſcabrous, where the *Longus*, *Brevis* and *Brachiæus externus* are inſerted. The *Olecranon* makes

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† Cubitus, πῆχυς, προπήχιον, Focile majus, Canna vel arundo major & inferior Brachii.

‡ Αγκῶν, Gibber, Cubitus, Additamentum necatum.

makes it unneceſſary that the Tendons of the extenſor Muſcles ſhould paſs over the End of the *Os humeri*, which would have been of ill Conſequence in the great Flexions of this Joint, or when any conſiderable external Force is applied to this Part, according to the juſt Remark of *Winſlow (a)*.——The anterior Proceſs is not ſo large, nor does it reach ſo high as the poſterior, but it is ſharper at its End, and therefore is named *Coronoid*.——Between theſe two Proceſſes, a large ſemicircular or *ſigmoid* Concavity is left; the Surface of which on each Side of a middle Riſing, is ſlanting, and exactly adapted to the Pulley of the Bone of the Arm.——Acroſs the Middle of it a ſmall Sinuoſity is ſtretched for lodging mucilaginous Glands; where, as well as in a ſmall Hollow on the internal Side of it, the Cartilage that lines the reſt of its Surface is wanting.——Round the Brims of this Concavity the Bone is rough, where the circular Ligament of the Joint is implanted.——Immediately below the *Olecranon* on the back part of the *Ulna*, a flat triangular ſpungy Surface appears, on which we commonly lean.——At the internal Side of this, there is a larger hollow Surface, where the *Muſculus Anconæus* is lodged, and the Ridge at the Inſide of this gives Riſe to the *Muſculus ſupinator radii brevis*.——Between the Top of this Ridge and the *coronoid* Proceſs, a ſemilunated ſmooth Cavity, lined with a Cartilage, is remarkable, in which the round Head of the *Radius* plays; immediately below it a rough Hol-

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(a) Expoſition Anatomique du Corps humain, Traitè des Os ſecs Sect. 979.

low gives Lodging to mucaginous Glands.—Below the Root of the *coronoid* Proceſs, this Bone is ſcabrous and unequal where the *Brachiæus internus* is inſerted; and on the Out-ſide of that we obſerve a ſmooth Concavity, where the Beginning of the *Flexor digitorum profundus* ſprouts out.

The Body of the *Ulna* is triangular.——The internal Angle is very ſharp, where the Ligament that connects the two Bones is fixed;——The Sides, which make this Angle are flat and rough, by the Action and Adheſion of ſo many Muſcles as are ſituated here.—At the Diſtance of one Third of the Length of the *Ulna* from the Top, in its anterior Surface, the Paſſage of the medullary Veſſels is to be remarked ſlanting upwards.——The external Side of this Bone is ſmooth, ſomewhat convex, and the Angles at each Edge of it are blunted, by the Preſſure of the Muſcles equally diſpoſed about them.

As this Bone deſcends it becomes gradually ſmaller, ſo that its lower End terminates in a very little Head, ſtanding on a ſmall Neck.——Towards the anterior but external Part of which laſt, an oblique Ridge runs, that gives Riſe to the *Pronator radii quadratus.*——The Head is round, ſmooth and covered with a Cartilage on its internal Side, to be received into the ſemilunar Cavity of the *Radius*; while from its Out-ſide a *Styloid* Proceſs † ſtands out, from which a ſtrong Ligament is extended to the *Os piſiforme* and *unciforme* of the Wriſt. ——Between the Back-part of that internal ſmooth Side and this Proceſs, a Sinuoſity is left for the Tendon of the Extenſor *carpi ulnaris*;—On the Out-ſide of the Root of the Proceſs, ſuch another Depreſſion may be remarked for the Paſſage of the *Flexor carpi ulnaris.* ——The End of the Bone is ſmooth and covered with a Cartilage, between which and the Bones of the Wriſt, a doubly-concave moveable Cartilage is interpoſed, which is a Continuation of the Cartilage that covers the lower End of the *Radius.*——At the Inſide of the Root of the *Styloid* Proceſs, a ſmall rough Cavity is formed for lodging mucilaginous Glands.

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† Γραφοειδῆ, Malleolus externus.

The *Ulna* is articulated above with the lower End of the *Os humeri* by *Ginglymus*, which allows of an eaſy and ſecure Extenſion to almoſt a ſtreight Line with the Arm, and of a Flexion to a very acute Angle; but by the ſlanting Poſition of the Pulley, the lower Part of the Fore-arm is turned outwards in the Extenſion, and inwards in the Flexion, as *Winſlow* *(a)* has remarked; and a very ſmall Kind of Rotation is likewiſe allowed of in all Poſitions, eſpecially when the Ligaments are moſt relaxed by the Fore-arm being in a middle Degree of Flexion.——The *Ulna* is alſo articulated with the *Radius* and *Carpus*, in a Manner to be related afterwards.

*RADIUS* †, ſo called from its imagined Reſemblance to a Spoke of a Wheel, or to a Weaver's Beam, is the Bone placed at the Inſide of the Fore-arm. Its upper End is formed into a circular little Head, which is hollowed for

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*a* Memoires de l' Acad. des Sciences 1722.

† Κερκὶς, παραπήχιον, Focile minus, Canna minor, Arundo minor.

for an Articulation by *Enarthroſis* with the Tubercle at the Side of the Pulley of the *Os humeri*; and the Half of the round Circumference of the Head next to the *Ulna* is ſmooth, and covered with a Cartilage, in order to be received into the ſemilunated Cavity of that Bone.— Below the Head, the *Radius* is much ſmaller; therefore this Part is named its *Cervix*, which is made round by the Action of the *Supinator radii brevis*:—— At the external Root of this Neck, a tuberous Proceſs riſes, into the exterior Part of which, the *Biceps flexor cubiti* is inſerted.—From this, a Ridge runs downwards and inwards, where the *Supinator radii brevis* and *Pronator radii teres* are inſerted.

The Body of the *Radius* is not ſtreight, but convex on its internal and poſterior Surfaces, where it is alſo made round by the equal Preſſure of the circumjacent Muſcles, particularly, of the *Extenſors* of the Thumb; but the Surfaces next to the *Ulna* are flatted and rough for the Origin of the Muſcles of the Hand, and both terminate in a common ſharp Spine, to which the ſtrong Ligament betwixt the two Bones of the Fore-arm is fixed.—— A little below the Beginning of the anterior plain Surface, where the *Flexor* Muſcle of the laſt Joint of the Thumb takes its Origin, the Paſſage of the medullary Veſſels is ſeen ſlanting upwards.—— Towards the lower End the *Radius* becomes broader and flatter, eſpecially on its Fore-part, where its *Pronator quadratus* Muſcle is ſituated.

The lower End is larger than the ſuperior, tho' not in ſuch a Diſproportion, as the upper End of the *Ulna* is larger than the inferior.—— The back Part of that tuberous Extremity has a flat ſtrong Ridge in the Middle, and *Foſſæ* on each Side.—— In a ſmall Groove immediately on the Outſide of the Ridge, the Tendon of the *Extenſor tertii internodii pollicis* plays.—— In a large one beyond this, the Tendons of the *Indicator* and common *Extenſor* Muſcles of the Fingers paſs.— Contiguous to the *Ulna*, there is a ſmall Depreſſion made by the *Extenſor minimi digiti*.—— On the inſide of the Ridge, there is a broad Depreſſion, which ſeems again ſubdivided, where the two Tendons of the *Bicornis* or *Extenſor carpi radialis* are lodged.--- The internal Side of this End of the *Radius*, is alſo hollowed by the Extenſors of the firſt and ſecond Joint of the Thumb;—immediately above which, a little rough Surface ſhews where the *Supinator radii longus* is inſerted.— The Forepart of this End is alſo depreſſed, where the Flexors of the Fingers and *Flexor carpi radialis* paſs.—The external Side is formed into a ſemilunated ſmooth Cavity, lined with a Cartilage, for receiving the lower End of the *Ulna*.--The Extremity of this Tuberoſity is formed into an oblong Cavity, in the Middle of which is a ſmall tranſverſe Riſing, gently hollowed, for lodging mucilaginous Glands; while the Riſing itſelf is inſinuated into the Conjunction of the two Bones of the Wriſt that are received here.—— The internal Side of this Articulation is fenced by a remarkable Proceſs * of the *Radius*, from which a Ligament goes out to the Wriſt, and the *Styloid* Proceſs of the *Ulna* guards it on the Outſide.

The Ends of both the Bones of the Fore-arm

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† Malleolus internus.

being thicker than their Middle, there is a conſiderable Diſtance between the Bodies of theſe Bones, in which a ſtrong tendinous but thin Ligament is extended, to give a large enough Surface for the Origin of the numerous Fibres of the Muſcles ſituated here, that are ſo much ſunk between the Bones as to be protected from Injuries, which they would otherwiſe be expoſed to.

Both Ends of the Bones of the Fore-arm, are firſt Cartilages, and then *Epiphyſes* in Children.

The *Radius* is articulated with the Tubercle of the *Os humeri* by *Enarthroſis*, and therefore is bended and extended along with the *Ulna*, while it may here move round its *Axis* in any Poſition; and that this Motion round its *Axis*, may be ſufficiently large, the Ligament of the Articulation is extended farther down than ordinary on the Neck of this Bone, before it is joined to it.——— This Bone is alſo joined to the *Ulna* by a double *Enarthroſis*, the *Radius* being received above, and the *Ulna* below; which conjunctly conſidered, form the third Species of *Ginglymus*: But then the Motion performed in theſe two is very different; for at the upper End, the *Radius* does no more than turn round its Axis, while at the lower, it moves in a certain Sort of *Cycloid*, upon the round End of the *Ulna*; and as the Hand is articulated and firmly connected here with the *Radius*, they muſt move together.——— When the Palm is turned uppermoſt, the *Radius* is ſaid to perform the *Supination*; when the Back of the Hand is above, it is ſaid to be *Prone*. But then the Quickneſs and large Extent of theſe two Motions are aſſiſted by the *Ulna*, which, as was before obſerved, can move with a kind of ſmall Rotation on the ſloping Sides of the Pulley. This lateral Motion, tho' very inconſiderable in the Joint itſelf, is conſpicuous at the lower End of ſuch a long Bone, and the ſtrong Ligament connecting this lower End to the *Carpus*, makes the Hand more readily to obey theſe Motions.—— When we deſign a large circular Turn of our Hand, we increaſe it by the Rotation of the *Os humeri*, and ſometimes employ the Spine and *inferior Extremities* to make theſe Motions of Pronation and Supination of the Hand large enough.

The *HAND* * comprehends all from the Joint of the Wriſt to the Points of the Fingers. All its poſterior Part is convex, for greater Firmneſs and Strength; and its anterior Part is on the contrary concave, for containing more ſurely and conveniently ſuch Bodies as we take hold of:——One half of the Hand has but an obſcure Motion, and ſerves as a Baſe to the other Half, which is endued with large Motion forwards, but can be extended back very little farther than to a ſtreight Line with the Fore-arm.

As the Bones that compoſe the Hand are of different Shapes and Uſes, while ſeveral of them that are adjoining, agree in ſome general Characters; the Hand is on this Account commonly divided into the *Carpus*, *Metacarpus* and *Fingers*, among which laſt the Thumb is reckoned.

The

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† Ἀκρόχειρ, ſumma Manus.

The *CARPUS* † is compoſed of eight ſmall ſpongy Bones, ſituated at the upper Part of the Hand. I ſhall deſcribe each of theſe Bones with *Lyſerus* (a) under a proper Name taken from their Figure, becauſe the Method of ranging them by Numbers, leaves Anatomiſts too much at Liberty to debate very idly, which ought to be preferred to the firſt Number: Or, which is worſe, ſeveral, without explaining the Order they obſerve, differently apply the ſame Numbers, and ſo confound their Readers.—— But that the Deſcription of theſe Bones may be in the ſame Order as they are found in the Generality of Anatomical Books, I ſhall begin with that Range of Bones, that are concerned in the moveable Joint of the Wriſt, or are connected to the Fore-arm, and ſhall afterwards conſider the four that ſupport the Thumb and *Oſſa Metacarpi* of the Fingers.

The eight Bones then of the *Carpus* are, *Os ſcaphoides*, *lunare*, *cuneiforme*, *piſiforme*, *trapezium*, *trapezoides*, *magnum*, and *unciforme*.

The *Scaphoides* is ſituated moſt internally of thoſe that are articulated with the Fore-arm.—— The *Lunare* is immediately on the Outſide of the former.—— The *Cuneiforme* is placed ſtill more externally, but does not reach ſo high up as the other two.—— The *Piſiforme* ſtands forwards into the Palm from the *Cuneiform*.—— The *Trapezium* is the firſt of the ſecond Row, and is ſituated betwixt the *Scaphoides* and firſt Joint of the Thumb.—— The *Trapezoides* is immediately on the Outſide of the *Trapezium*.——

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† Κτεὶς, Brachiale, prima palmæ pars, raſetta.

(a) Cult. Anat. lib. 5. cap. 2.

The *Os magnum* is ſtill more external;—— The *Unciforme* is fartheſt to the Side of the little Finger.

*Scaphoides*[†] is the largeſt of the eight except one, ſituated on the Inſide of the Joint of the Wriſt.-- It is convex above, concave and oblong below; from which ſmall Reſemblance of a Boat it has got its Name.-- Its ſmooth convex Surface is divided by a rough middle *Foſſa*, which runs obliquely croſs it.-- The ſuperior largeſt Diviſion is articulated with the *Radius*.--Into the *Foſſa* the common Ligament of the Joint of the Wriſt is fixed; and the inferior Diviſion is joined to the *Trapezium* and *Trapezoides*—The Concavity receives more than an Half of the round Head of the *Os magnum*.—— The external Side of this Hollow is formed into a ſemi-lunar Plain, to be articulated with the following Bone.—— The internal, poſterior and anterior Edges are rough, for fixing the Ligaments that connect it to the ſurrounding Bones.

*Os lunare*[‡] ſituated immediately on the Outſide of the preceeding Bone, has a ſmooth convex ſuperior Surface, by which it is articulated with the *Radius*.—The internal Side is in Form of a Creſcent, by which it is joined with the *Scaphoid* and from this the Name of this *Os lunare* is taken;— the inferior Surface is hollow, for receiving Part of the Head of the *Os magnum*.-- On the Outſide of this Cavity is another ſmooth, but narrow oblong Sinuoſity, for receiving the upper End of the *Os unciforme*;—on the Outſide of which a ſmall round Convexity, is found for its Connexion with the *Os cuneiforme.*—— Between the great ſuperior Convexity, and the firſt deep inferior Cavity there is a rough *Foſſa*, in which the circular Ligament of the Joint of the Wriſt is fixed.

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[†] Κοτυλοειδὲς, Naviculare.

[‡] Lunatum.

*Os cuneiforme* * is ſituated on the external and inferior Side of the *Os lunare.*——It is broad above, and gradually turns ſmaller below; which gives it the Reſemblance of a Wedge. —— The ſuperior Surface is almoſt plain, and included in the Joint of the Wriſt, being oppoſed to the lower End of the *Ulna*. Below this the cuneiform Bone has a rough *Foſſa*, wherein the Ligament of the Articulation of the Wriſt is fixed.—— On the internal Side of this Bone, where it is contiguous to the *lunare*, a ſmooth ſlightly concave Surface is formed.—— Its inferior Surface is oblong, ſomewhat ſpiral and concave, for its Connexion with the *Os unciforme.*—— Near the Middle of its anterior Surface a circular Plain appears, where the *Os piſiforme* is ſuſtained.

*Os piſiforme* † is almoſt ſpherical, except one circular Plain, or ſlightly hollow Surface, that ſtands on the *cuneiform* Bone, from which its whole Body is prominent forwards into the Palm; and ſerves for fixing the croſs Ligament that defends the Tendons of the Flexors of the Fingers, and the Ligament which proceeds from the End of the *Ulna.*——Into this Bone likewiſe the *Flexor carpi ulnaris* is inſerted; and from it the *Abductor*, and Part of the *Flexor primi internodii minimi digiti*, , or rather Flexor of the fourth metacarpal Bone, have their Origin; and at the internal Side of it a ſmall Depreſſion is formed, for the Paſſage of the ulnar Nerve.

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* Triquetrum.

† Cartilaginoſum, ſubrotundum, rectum.

*Trapezium* † is placed above the firſt Bone of the Thumb.—— It is broad and flat at its anterior and poſterior Surfaces; whence it is imagined to reſemble a Table.——— Its ſuperior ſmooth Surface is ſlightly hollowed and ſemicircular, for its Conjunction with the *Os ſcaphoides*.——— Its external Side is an oblong concave Square, for receiving the following Bone.——— The inferior Surface is formed into a Pulley, the two protuberant Sides of which are external and internal. On this Pulley the firſt Bone of the Thumb is moved.— At the external Side of the external Protuberance, a ſmall oblong ſmooth Surface is formed by the *Os metacarpi indicis*.——— The anterior Part of the *Trapezium* is prominent in the Palm, and near to the external Side, has a Sinuoſity in it, where the Tendon of the *Flexor carpi radialis* is lodged, on the ligamentous Sheath of which the Tendon of the *Flexor tertii internodii pollicis* plays; and ſtill more externally the Bone is more ſcabrous than ordinary, where the croſs anterior Ligament of the Wriſt is connected, and the *Abductor* and *Flexor primi internodii pollicis* have their Origin.

*Os trapezoides* ‡ is the ſmalleſt Bone of the Wriſt, except the *piſiforme*, ſituated on the Outſide of the *Trapezium*.—— The Figure of it is an irregular Cube.—— It has a ſmall ſuperior hollow Surface, by which it joins the *ſcaphoides*; a long convex one internally, where it is contiguous to the *Trapezium*; a ſmall external one, for its Conjunction with the *Os magnum*; and an inferior convex Surface, the anterior and poſterior Edges of which are however raiſed, ſo that a Sort of Pulley is formed at this Place, where it ſuſtains the *Os metacarpi indicis*.

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† Os cubiforme, trapezoides, multangulum majus.
‡ Trapezium, multangulum minus.

*Os magnum* †, ſo called, becauſe it is the largeſt Bone of the *Carpus*, is oblong, almoſt ſquare, with a round upper End, and a triangular inferior plain one.—— The round Head is divided by a ſmall Riſing, oppoſite to the Connexion of the *Os ſcaphoides* and *lunare*, which together form the Cavity for receiving it.—— On the Inſide a ſhort plain Surface joins the *Os magnum* to the *Trapezoides*.—— On the Outſide is a long narrow concave Surface, where it is contiguous to the following Bone.— The inferior triangular End, which ſuſtains the metacarpal Bone of the middle Finger, is ſlightly hollowed, and farther advanced on the internal Side than on the external, having a conſiderable oblong Depreſſion made on that advanced Inſide by the metacarpal Bone of the Fore-finger.

*Os unciforme* ‡ has got its Name from a thin broad Proceſs that ſtands out from it forwards into the Palm, and is hollow on its Inſide, for affording a Paſſage to the Tendons of the

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† Maximum, capitatum.
‡ Cuneiforme.

Flexors of the Fingers. To this Proceſs alſo the croſs Ligament is fixed, that binds down and defends theſe Tendons, and the *Flexor* and *Abductor* Muſcles of the little Finger riſe from it.——The ſuperior plain Surface is ſmall and convex to be joined with the *Os lunare*:——The internal Side is long and ſlightly convex, adapted to the adjoining *Os magnum*:——The external Surface is oblique and irregularly convex to be articulated with the cuneiform Bone:——The inferior End is divided into two concave Surfaces; the external for the metacarpal Bone of the little Finger, and the internal for that of the Ring-finger.

In the Deſcription of the preceding eight Bones, I have only mentioned thoſe plain Surfaces covered with Cartilage, by which they are articulated to each other, or to ſome other Bones, except in ſome few Caſes, where ſomething extraordinary was to be obſerved; and I have deſignedly omitted the other rough Surfaces; leſt by crowding too many Words in the Deſcription of ſuch ſmall Bones, the whole ſhould be unintelligible: But theſe ſcabrous Parts of the Bones may eaſily be underſtood, after mentioning their Figure, if it is obſerved, that they are generally found only towards the Back or Palm of the Hand, that they are all plain, larger behind than before, and that they receive the different Ligaments, by which they are either connected to neighbouring Bones, or to one another; for theſe Ligaments cover all the Bones, and are ſo accurately applied to them, that, as *Galen* (*a*) obſerves, at firſt

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(*a*) De uſu Part. 2. Lib. Cap. 8.

View the whole *Carpus* of a recent Subject appears one ſmooth Bone.

As the poſterior Surfaces of theſe Bones are largeſt, the Figure of the whole conjoined muſt therefore be convex behind, and concave before; which Concavity is ſtill more increaſed by the *Os piſiforme*, and Proceſs of the *Os unciforme*, ſtanding inwards on one Side, as the *Trapezium* does on the other.—— The Convexity behind renders the whole Fabrick ſtronger, where it is moſt expoſed to Injuries; and the large anterior Hollow is neceſſary for a ſafe Paſſage to the numerous Tendons of the Fingers. This Figure is likewiſe ſecured by the ſtrong croſs Ligament ſtretched from one Side to the other.

The Subſtance of theſe Bones is ſpungy and cellular, but ſtrong in reſpect of their Bulk.

The three firſt make an oblong Head, by which they are articulated to the lower Ends of the Bones of the Fore-arm by *Enarthroſis*; and therefore can be moved to all Sides, and by a quick Succeſſion of theſe Motions, may be moved in a Circle. But as the Joint is oblong, and therefore the two Dimenſions are unequal, no Motion is allowed to the *Carpus* round its Axis, except what it has in the Pronation and Supination along with the *Radius*.—— The Articulation of the firſt three Bones of the ſuperior Row, with the Bones of the inferior, is ſuch as allows of Motion, eſpecially backwards and forwards; to the Security and Eaſineſs of which the *Enarthroſis* of the *Os magnum*, with the *Scaphoides* and *lunare* contributes conſiderably: And the greateſt Number of the Muſcles that ſerve for the Motion of the

Wriſt on the *Radius*, being inſerted beyond the Conjunction of the firſt Row of Bones with the ſecond, act equally on this Articulation as they do on the former; but the Joint formed with the *Radius*, being the moſt eaſily moved, the firſt Effect of theſe Muſcles will be on it, and the ſecond Row of the *Carpus* is only moved afterwards. By this Means a larger Motion of the Wriſt is allowed than otherwiſe it could have had ſafely: For, if as large Motion had been given to one Joint, the Angle of Flexion would have been very acute, and the Ligaments muſt have been longer than was conſiſtent with the Firmneſs and Security of the Joint.—The other Articulations of the Bones here being by nearly plain Surfaces, which I called *Arthrodia*, ſcarce allow of any more Motion, becauſe of the ſtrong connecting Ligaments, than to yield a little, and ſo elude the Force of any external Power; and to render the Back of the Wriſt a little more flat, or the Palm more hollow on proper Occaſions. The Articulations of the Thumb and metacarpal Bones ſhall be examined hereafter.

The Uſes of the *Carpus* are, to ſerve as a Baſe to the Hand, to protect its Tendons, and to afford it a free large Motion.

All the Bones of the *Carpus* are in a cartilaginous State at the Time of Birth.

*METACARPUS* * conſiſts of four Bones, which ſuſtain the Fingers.—Each Bone is long and round, with the Ends larger than the Body. — The upper End, which ſome call the Baſe, is

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† Κτεὶς, προκάρπιον, στῆθος, ἄνδηρον, κτενίον. Poſtbrachiale, pectus, palma, pecten.

is flat and oblong, without any conſiderable Head or Cavity; but is however ſomewhat hollowed for the Articulation with the *Carpus*: And on one or both Sides this Baſe is flatned and ſmooth, where theſe Bones are contiguous to each other.—— Their Bodies are ſomewhat round, but are flatned by the Tendons of the Extenſors of the Fingers on their poſterior Surface, from near their Middle to their lower End.——The anterior Surface of theſe Bodies is a little concave, eſpecially in their Middle; along which a ſharp Ridge ſtands out, which ſeparates the *Muſculi interoſſei*, placed on each Side of theſe Bones, which are there made flat and plain by theſe Muſcles.

Their lower Ends are raiſed into large oblong ſmooth Heads, whoſe greateſt Extent is forwards from the Axis of the Bone.—— At the anterior Root of each of theſe Heads, one or two Tubercles ſtand out for ſecuring the Ligaments of the Joint, and for fixing the Ligaments that go from one metacarpal Bone to another, to preſerve them from being drawn aſunder:—— Round the Heads a rough Ring may be remarked, for the circular Ligaments of the Joints to be fixed to; and both Sides of theſe Heads are flat, by preſſing on each other. — The Length of theſe Bones is generally diminiſhed, in proportion to their Diſtance from the Thumb.

The Subſtance of the metacarpal Bones is the ſame with that of all long Bones.

At the time of Birth theſe Bones are cartilaginous at both Ends, which afterwards become *Epiphyſes*.

Tho' the *Oſſa Metacarpi* ſo far agree, yet they may be diſtinguiſhed from each other by the following proper Characters.

The *Os metacarpi indicis* is generally the longeſt.——Its Baſe, which is articulated with the *Trapezoides*, is hollow in the Middle.——The ſmall Ridge on the internal Side of this oblong Cavity is ſmaller than the one oppoſite to it, and is made flat on the Side by the *Trapezium*.——The exterior Ridge is alſo ſmooth and flat on its Outſide, for its Conjunction with the *Os magnum*; immediately below which a ſemicircular ſmooth flat Surface ſhews the Articulation of this Bone to the following one. ——The poſterior Part of this Baſe is flatted where the long Head of the *Extenſor carpi radialis* is inſerted, and its Fore-part is prominent where the Tendon of the *Flexor carpi radialis* is fixed.——The external Side of the Body of this Bone is more hollowed by the Action of Muſcles than the internal.——The Tubercle at the internal Root of its Head is larger than the external.

*Os metacarpi medii digiti* is generally the ſecond in Length, but often it is as long as the former, ſometimes it is longer; and frequently it only appears to equal the firſt, by the *Os magnum* being farther advanced downwards than any other Bone of the Wriſt.——Its Baſe is a broad ſuperficial Cavity, ſlanting outwards; the internal poſterior Angle of which is ſo prominent as to have the Appearance of a Proceſs. ——The internal Side of this Baſe is made plain in the ſame Way as the external Side of the former Bone, while its external Side has two hollow circular Surfaces, for joining the following; and between theſe Surfaces a rough

*Foſſa* is found, for the Adheſion of a Ligament, and lodging mucilaginous Glands.--The ſhorter Head of the *Bicornis* is inſerted into the Back-part of this Baſe.—— The two Sides of this Bone are almoſt equally flatted, only the Ridge on the anterior Part of the Body is inclined more externally.——The Tubercles at the anterior Root of the Head are equal.

*Os metacarpi digiti annularis* is of a ſemicircular Figure, and convex at its Baſe, for its Conjunction with the *Os unciforme.*——On its internal Side are two ſmooth Convexities and a middle *Foſſa*, adapted to the former Bone; ——The external Side has a triangular ſmooth concave Surface, to join it with the following. ——The anterior Ridge of its Body is ſituated more to the Out-ſide.——The Tubercles near the Head are equal.

*Os metacarpi minimi digiti* is the ſmalleſt and ſharpeſt.——Its Baſe is irregularly convex, and riſes ſlanting outwards.——Its internal Side is exactly adapted to the former Bone.——The external has no ſmooth Surface, becauſe it is not contiguous to any other Bone, but it is prominent where the *Extenſor carpi ulnaris* is inſerted.——As this *Os metacarpi* is furniſhed with a proper moving Muſcle, has the plaineſt Articulation, is moſt looſely connected and leaſt confined, it enjoys a much larger Motion than any of the reſt; ſo that the Palm of the Hand may be conſiderably hollowed by the Advance of this Bone forwards, and by the Prominence of the Thumb oppoſite to it.

The metacarpal Bones are joined above to the *Oſſa carpi* by *Artbrodia*; but ſeveral of them having different Surfaces, by which they are contiguous to each other, their Articulation comes under what I called the third Species of *Ginglymus.*——The Motion is not conſiderable in any of them, but the exterior have more than thoſe that are placed nearer to the Thumb.—Their Articulations with the firſt *Phalanx* of the Fingers is by *Enarthroſis.*

Theſe four Bones make the Hand very capacious by their Length, their anterior Concavity forming the Hollow of the Palm, which can be increaſed at pleaſure by the Motion forwards of the more external of theſe Bones.——The Interſtices between them allow ſome Muſcles and their Tendons to paſs ſecurely, and afford Origin and Lodging to other Muſcles.——On their round Heads the Fingers move freely.

The *THUMB* and four *FINGERS* are each compoſed of three long Bones, that enjoy a large Motion.——The Bones are formed after the ſame Manner in the different Fingers; but the Thumb differs from them in its Structure, and therefore ought to be conſidered ſeparately.——

The *Thumb* † is ſituated obliquely in reſpect of the Fingers, neither oppoſite directly to them, nor in the ſame Plain with them.——All its Bones are much thicker and ſtronger in Proportion to their Length; Which was extremely neceſſary, ſince the Thumb counteracts all the Fingers.

The firſt Bone of the Thumb has its Baſe adapted to the double Pulley of the *Trapezium*: For in viewing it from one Side to the other, it appears convex in the Middle; but when conſidered from behind forwards, it is concave there. —The anterior Edge of this Baſe is produced farther than any other Part; and round the poſterior Edge of the Baſe a rough *Foſſa* may be ſeen, for the Connexion of the Ligaments of this Joint.—The Body and Head of this Bone are of the ſame Shape as the *Oſſa metacarpi*; only that the Body is ſhorter, and the Head flatter, with the Tubercles at its anterior Root larger.

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† Ἀντίχειρ, δικονδυλὸς, Magnus digitus, promanus.

The Articulation of this Bone is uncommon. For tho' it is a *Ginglymus*, yet it enjoys the Motion of an *Enarthroſis*, by being formed into a double Pulley; only it is ſomewhat more confined and leſs expeditious, but ſtronger and more ſecure, than generally the *Enarthroſis* is.

This Bone of Children is in the ſame State with the metacarpal Bones.

The ſecond Bone of the Thumb has a large Baſe formed into an oblong Cavity, whoſe greateſt Length is from one Side to the other. —Round it ſeveral Tubercles may be remarked, for the Inſertion of Ligaments.——Its Body is convex, or a half-round behind; but flat before, for lodging the Tendon of the long Flexor, which is tied down by ligamentous Sheaths that are fixed on each Side to the Angle at the Edge of this flat Surface.——The lower End of this ſecond Bone has two lateral round Protuberances, and a middle Cavity, whoſe greateſt Extent of ſmooth Surface is forwards.

The Articulation and Motion of this ſecond Bone is as ſingular as that of the former.—— For its upper End is articulated by *Enarthroſis*; yet becauſe of the Strength of its lateral

Ligaments, oblong Figure of the Joint itſelf, and Mobility of the firſt Joint, it only has the two Motions of a *Ginglymus*, Flexion and Extenſion, and theſe are generally much confined.

The third Bone of the Thumb is the ſmalleſt, with a large Baſe, whoſe greateſt Extent is from one Side to the other.——This Baſe is formed into two Cavities and a middle Protuberance, to be adapted to the Pulley of the former Bone. ——Its Body is rounded behind, but is flatter than in the former Bone, for ſuſtaining the Nails.——It is flat and rough before, by the Inſertion of the *Flexor tertii internodii*.—— This Bone becomes gradually ſmaller, till near the lower End, where it is a little enlarged, and has an oval ſcabrous Edge.

The Motion of this third Bone is proper to its Articulation *Ginglymus*.

The orderly Diſpoſition of the Bones of the Fingers into three Rows has made them generally obtain the Name of three *Phalanges* †.—— All of them are ſituated with their half-round Surfaces directly backwards, for their greater Strength, and with the flat concave Part before, for taking hold more ſurely, and for lodging the Tendons of the Muſcles that move them. ——The Ligaments for keeping down the Tendons of the Flexor Muſcles, are fixed to the Angle that is on each Side between the poſterior Convexity and this anterior Concavity.—— Theſe Bones are ſmaller, in proportion to their Lengths, than the Bones of the Thumb, as was already remarked.

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† Scytalidæ, internodia, ſcuticula, agmina, acies, condyli, articuli.

The Bones of the firſt *Phalanx* ‡ of the Fingers anſwer to the Deſcription of the ſecond Bone of the Thumb; only that the Cavity in their Baſe is not ſo oblong, nor is their Motion on the metacarpal Bones ſo much confined; for they can be moved laterally or circularly, but have no Rotation round their Axes.

Both the Ends of this firſt *Phalanx* is in a cartilaginous State at the Birth, and the ſuperior is afterwards affixed in Form of an *Epiphyſis*.

The ſecond Bone † of the Fingers has its Baſe formed into two lateral Cavities, and a middle Protuberance; while the lower End has two lateral Protuberances and a middle Cavity; therefore it is joined at both Ends by *Ginglymus*, which none of the Bones of the Thumb are.

This Bone is in the ſame Condition with the former in Children.

The third Bone ‡ differs nothing from the Deſcription of the third Bone of the Thumb, excepting in the general diſtinguiſhing Marks; and therefore the ſecond and third *Phalanx* of the Fingers enjoy only Flexion and Extenſion.

The upper End of this third *Phalanx* is a Cartilage in a ripe Child, and is only an *Epiphyſe* after, till the full Growth of the Body.

All the Difference of the *Phalanges* of the ſeveral Fingers conſiſts in their Magnitude.—

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‡ Προκόνδυλοι.

† Κόνδυλοι.

‡ Μετακόνδυλοι, ῥιζωνύχια.

The Bones of the *Middle-finger* † being the longeſt and largeſt,—thoſe of the *Fore-finger* ‡ come next to that.—Thoſe of the *Ring-finger* † are the third in Size, and the *Little-finger* ‡ has the ſmalleſt Bones. Which Diſpoſition is the beſt Contrivance for holding the largeſt Bodies; becauſe the longeſt Fingers are applied to the middle largeſt Periphery of ſuch Subſtances as are of a ſpherical Figure, as was remarked of old by *Galen (a)*.

The Uſes of our *ſuperior Extremities*, and their ſeveral Parts, are ſo evident in all the common Actions of Life, that they muſt readily occur to the meaneſt Capacity; and therefore, without mentioning any of them, I ſhall proceed to the laſt Part of the Skeleton: Only, leſt I ſhould ſeem to have forgot the ſmall Bones at the Joints of the Hand, I deſire now to refer to the Deſcription of them, under the common Title of *Seſamoid Bones*, which I have placed after the Bones of the Feet.

## *Of the inferior Extremities.*

THE *INFERIOR EXTREMITIES* comprehend all thoſe Parts depending from the *Acetabula* of the *Oſſa innominata*, and are commonly divided into three Parts, *viz*. the Thigh, Leg and Foot.

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† *Καταπυγὼν, σφάκελος*, infamis, impudicus, verpus, famoſus, obſcænus.

‡ *Δεικτικὸς*, indicator, *λειχανὸς*, demonſtrativus, ſalutaris.

† *Ἰατρικὸς, παράμεσος, δακτυλιώτης, ἐπιβάτης*, Annularis, medicus, cordis digitus.

‡ *Μύωψ. ὠτίτης*, Auricularis, minimus.

(*a*) De uſu part. lib. 1. cap. 24.

The *THIGH* [†] has only one Bone, which is the longeſt of the Body, and the largeſt and ſtrongeſt of any of the cylindrical Bones. The Situation of it is not perpendicular: For the lower End is inclined conſiderably inwards; ſo that the Knees are almoſt contiguous, while there is a conſiderable Diſtance between the Thigh-bones above: Which is of good Uſe to us, ſince ſufficient Space is thereby left for the external Parts of Generation, the two great *Cloacæ* of Urine and *Fæces*, and for the large thick Muſcles that move the Thigh inwards; and at the ſame Time this Situation of the Thigh-bones renders our Progreſſion quicker, ſurer, ſtreighter, and in leſs Room. For had the Knees been at a greater Diſtance from each other, we muſt have been obliged to deſcribe ſome Part of a Circle with the Trunk of our Body in making a long Step, and, when one Leg was raiſed from the Ground, our Centre of Gravity would have been too far from the Baſe of the other, and we ſhould conſequently have been in Hazard of falling; ſo that our Steps would neither have been ſtreight nor firm, nor would it have been poſſible to walk in a narrow Path, had our Thigh-bones been otherwiſe placed. In conſequence however of the Weight of the Body, bearing ſo obliquely on the Joint of the Knee by this Situation of the Thigh-bones, it is that weak rickety Children become inkneed.

The upper End of the Thigh-bone is not continued in a ſtreight Line with the Body of it, but is ſet off obliquely inwards and upwards, whereby the Diſtance here between theſe two Bones at their upper Part is conſiderably increaſed.—This End is formed into a large round Head †, which is the greater Portion of a Sphere unequally divided, which is ſmooth and covered with a Cartilage to play in the *Acetabulum Iſchii.*——Towards its inferior internal Part a round rough ſpungy Pit is obſervable, where the ſtrong Ligament, commonly called the *round* one, tho' its tranſverſe Section is rather of an oval Figure, is fixed, to be extended from thence to the lower internal Part of the receiving Cavity, where it is conſiderably broader than in its Progreſs to the Head of the Thigh-bone.——The ſmall Part below the Head, called the *Cervix* of the *Os Femoris*, has a great many large Holes, into which the Fibres of the ſtrong Ligament that covers it enter, and are thereby ſurely united to it; and round the Root of the Neck where it riſes from the Bone, a rough Ridge is found, where the circular Ligament of the Articulation is connected.——Below the back Part of this Root, the large unequal Protuberance, called the *Trochanter major* ‡ is obſervable; at the upper Part of the Root of which, a Cavity is left for the Inſertion of the *Muſculus glutæus minimus*; and immediately on the Outſide of this, there is another Cavity where the *Pyriformis*, *Marſupialis* and *Gemini* are inſerted.—The upper End of this Proceſs has a ſmooth flat Surface, where the *Glutæus medius* is attached; more externally and below this, there is a large ſmooth Surface for the Inſertion of the *Glutæus maximus*.—From the back

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[†] Μηρὸν, Femen, coxa, agis, anchæ os, crus, femur.

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† Vertebrum.

‡ Γλουτὸς, Rotator natis, malum granatum teſticulorum.

Part of the Root of this great *Trochanter*, a rough Ridge runs backwards and downwards, into which the *Quadratus* is inſerted.——In the Hollow, at the internal Side of this Ridge, the *Obturator externus* is implanted.—More internally, a conoid Proceſs called *Trochanter minor* † riſes for the Inſertion of the *Muſculus Pſoas*, and *Iliacus internus*, and the *Pectineus* is implanted into a rough Hollow below its internal Root.——The Muſcles inſerted into theſe two Proceſſes being the principal Inſtruments of the rotatory Motion of the Thigh, have occaſioned the Name of *Trochanters* to the Proceſſes.

The Body of the *Os femoris* is convex on the Fore-part, and made hollow behind by the Action of the Muſcles that move upon it, and for the Conveniency of ſitting, without bearing ſo much on theſe Muſcles; and probably the Weight of the Legs depending from the Thighs in that Poſture contributes not a little to this Curvature.———The anterior Surface of the Thigh-bone is a little flatted above by the Beginning of the *Crureus* Muſcle, as it is alſo below by the *Rectus* and *Crureus*.——Its external Surface is likewiſe made flat below by the *Vaſtus externus*, where it is ſeparated from the former by an obtuſe Ridge.——The *Vaſtus internus* depreſſes a little the internal inferior Surface.——The poſterior concave Surface has a Ridge riſing in its Middle, commonly called *Linea aſpera*, into which the *Triceps* is inſerted. ——At the upper Part of it the medullary Veſſels enter by a ſmall Hole that runs obliquely upwards.———A little above which there is a rough *Foſſa* or two, where the tendinous Expanſion of the *Glutæus maximus* is fixed.——The lower End of the *Linea aſpera* divides into two, which deſcend towards each Side, the long Head of the *Triceps* being inſerted into the internal, and the ſhort Head of the *Biceps Flexor Tibiæ* riſing from the external. ——Between theſe two rough Lines, the Bone is made flat by the large Blood-veſſels and Nerves which paſs upon it; and near the End of each of theſe Ridges, a ſmall ſmooth Protuberance may often be remarked, where the two Heads of the *Muſculi Gaſtrocnemii externi* take their Riſe; and where the ſeſamoid Bones deſcribed by *Veſalius* (a) are found ſometimes.

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† Rotator minor.

The lower End of the *Os femoris* is larger than any other Part of it, and formed into a great Protuberance on each Side, called its *Condyles*; between which a conſiderable Cavity is found, eſpecially at the poſterior Part, in which the crural Veſſels and Nerves ly immerſed in Fat. —The internal Condyle is longer than the external, which muſt happen from the oblique Poſition of this Bone, to give leſs Obliquity to the Leg. —Each of theſe Proceſſes ſeems to be divided in its plain ſmooth Surface. The Mark of Diviſion on the external is a Notch, and on the internal a Protuberance. The Fore-part of this Diviſion, on which the *Rotula* moves, is formed like a Pulley, the external Side of which is higheſt.——Behind, there are two oblong large Heads, whoſe greateſt Extent is backwards for the Motion of the *Tibia*; and from the rough Cavity between them, but near to the Baſe of the

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(a) Lib. 1. cap. 28. & 30.

the internal Condyle, the ſtrong Ligament, commonly called the *croſs* one, has its Riſe.—— The Condyles both on the Outer and Inner-ſide of the Knee are made flat by the Muſcles paſſing along them.——On the Back-part of the internal a ſlight *Foſſa* is made by the Tendons of the *Gracilis* and *Sartorius*; and on the external a conſiderable Depreſſion is formed by the *Biceps flexor cruris.*———A little farther forward than where theſe Depreſſions are on each of the Condyles, the lateral Ligaments of the Joint of the Knee riſe out from the *Os femoris.* ——Round this lower End of the Thigh-bone, large Holes are found, into which the Ligaments for the Security of the Joint are fixed, and Blood-veſſels paſs to the internal Subſtance of the Bone.

All the Proceſſes of the *Femur* are cartilaginous in new born Children, and afterwards become ſmall *Apophyſes*, with large *Epiphyſes*.

The Thigh-bone is articulated above with the *Acetabulum* of the *Oſſa innominata* by *Enarthroſis*, and therefore can be moved to every Side, but is reſtrained in its Motion outwards by the high Brims of the Cavity, and by the round Ligament; for otherwiſe the Head of the Bone would have been frequently thruſt out at the Breach of the Brims on the Inſide, which allows the Thigh to move conſiderably inwards.——The Body of this Bone enjoys little or no rotatory Motion, though the Head moſt commonly moves round its own Axis, becauſe the oblique Progreſs of the Neck and Head from the Bone is ſuch, that the rotatory Motion of the Head can only bring the Body of the Bone forwards and backwards; nor is this

Head, as in the Arm, ever capable of being brought to a ſtreight Direction with its Body; ſo far however as the Head can move within the Cavity in a Circle backwards and forwards, the reſt of the Bone may have a partial Rotation.——The *Os femoris* is articulated below to the *Tibia* and *Rotula* by *Ginglymus*.

The *LEG* † is compoſed, according to the common Account, of two Bones, *Tibia* and *Fibula*, tho' it ſeems to have a very good Title to a third, the *Rotula*; ſince this, tho' a diſtinct Bone, bears a ſtrong Analogy to the *Olecranon* or ſuperior great Proceſs of the *Ulna*; therefore I ſhall rank the *Rotula* with theſe two other Bones.

*TIBIA* ‡, ſo called from its Reſemblance to an old Muſical Pipe or Flute, is the long thick triangular Bone, ſituated at the anterior internal Part of the Leg, and continued in almoſt a ſtreight Line from the Thigh-bone.

The upper End of the *Tibia* is large, bulbous and ſpungy, and is divided into two Cavities by a rough irregular Protuberance †, which is hollow at its moſt prominent Part, as well as before and behind. The anterior of the two Ligaments that compoſe the great *Croſs* one, is inſerted into the middle Cavity, and the poſterior Depreſſion of this irregular Proceſs receives the poſterior Ligament.——The two broad Cavities at the Sides of this Protuberance are not equal; for the internal is oblong and deep to re-

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† Κνήμη, Crus, tibia.

‡ Περικνήμιον, ἀντικνήμιον, focile majus, arundò major, canna major, canna domeſtica cruris.

† Διάφυσις, ἐξοχὴ νευροχονδρώδης, Tuber, Tuberculum.

ceive the internal *Condyle* of the Thigh-bone; while the external is more ſuperficial and rounder for the external Condyle.——In each of theſe two Cavities in a recent Subject a ſemilunar Cartilage is placed, which is thick at its convex Edge, and becomes gradually thinner towards the concave or interior Edge.—— The Middle of each of theſe Cartilages is broad, and the Extremities turn narrower and thinner, as they approach the middle Protuberance of the *Tibia*.——The thick convex Edge of each Cartilage is connected to the circular Ligament of the Articulation, but ſo near to its Riſe from the *Tibia* that the Cartilages are not allowed to change Places far; while the narrow Extremities of theſe Cartilages becoming almoſt Ligaments, are fixed at the Inſertion of the ſtrong croſs Ligament into the *Tibia*, and ſeem to have their Subſtance united with it; therefore a circular Hole is left between each Cartilage and the Ligament, in which the moſt prominent convex Part of each Condyle of the Thigh-bone moves.——In the Circumference of theſe Cavities deſcribed, the *Tibia* is rough and unequal for the firm Connexion of the Ligaments of the Joint.——Immediately below its poſterior Edge two rough flatted Protuberances ſtand out: Into the internal the Tendon of the *ſemimembranoſus* Muſcle is inſerted; and ſome Part of the croſs Ligament is fixed to the external. ——On the Outſide of this laſt Tubercle, a ſmooth ſlightly-hollowed Surface is formed by the Action of the *Poplitæus* Muſcle.

Below the Fore-part of the upper End of the

*Tibia*, a conſiderable rough Protuberance † riſes, to which the ſtrong tendinous Ligament of the *Rotula* is fixed.——On the internal Side of this, a ſcabrous Cavity is formed, where the *ſemi-nervoſus*, *gracilis* and *ſartorius* Muſcles are inſerted. This points out the Part where the *Tibia* ought to be ſawed through in an Amputation, ſo as not to have too long and troubleſome a Stump, and at the ſame time to preſerve its Motions, by ſaving the proper Muſcles.——Below the external Edge, a circular flat Surface covered in a recent Subject with Cartilage, is found for the Articulation of the *Fibula*.—Between which and the anterior Knob there is a rough Hollow from which the *Tibialis anticus* and *Extenſor digitorum longus* take their Origin.——From the ſmooth flat Surface, a Ridge runs obliquely downwards and inwards, to give Riſe to the *Tibialis poſticus*.——At the Inſide of this Ridge, an oblique plain Surface is left, where the *Muſculus Poplitæus* is inſerted, and Part of the *Solæus* has its Origin.——The remaining Body of the *Tibia* is triangular.—The anterior Angle is very ſharp, and is commonly called the *Spine* or *Shin* ‡: This Ridge is not ſtreight, but turns firſt inwards, then outwards, and laſtly inwards again.——The plain internal Side is ſmooth and equal, being little ſubjected to the Actions of Muſcles; but the external Side is hollowed above by the *Tibialis anticus*, and below by the *Extenſor digitorum longus*, and *Extenſor pollicis longus*.——The two Angles behind theſe Sides are rounded by the Action of the Muſcles;—The poſterior Side comprehended between them, is not ſo broad as thoſe already mentioned, but is more oblique and flatted by the Action of the *Tibialis poſticus* and *Flexor digitorum longus*.—Some Way above the Middle of the Bone, the internal Angle terminates, and the Bone is made round, but rough, by the Preſſure of the *Muſculus ſolæus*.——Near to this, the Paſſage of the medullary Veſſels is ſeen ſlanting obliquely downwards in the poſterior plain Surface.

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† Ἀντικνήμιον, Anterior Tuber.

‡ Ἄκανθα, Spina, crea, linea prima tibiæ, angulus acutus.

The lower End of the *Tibia* is made hollow, but ſo as a ſmall Protuberance riſes in the Middle.—The internal Side of this Cavity, which is ſmooth and, in a recent Subject, is covered with a Cartilage, is produced into a conſiderable Proceſs, commonly named *Malleolus internus* †, the Point of which is divided by a Notch, and from it Ligaments are ſent out to the Foot.——We ought to obſerve here with *Winſlow* (a), that this internal *Malleolus* is ſituated more forwards than the internal Condyle of the upper End of this Bone, which is neceſſary to be remarked in reducing a Fracture of the Leg.—The external Side of this End of the *Tibia* has a rough irregular ſemilunar Cavity formed in it, for receiving the lower End of the *Fibula*.—The poſterior Side has two lateral Grooves, and a ſmall middle Protuberance. In the internal Depreſſion, the Tendon of the *Muſculus tibialis poſticus* is lodged; and in the external, the Tendon of the *Flexor longus digitorum* plays.—— From the middle Protuberance, ligamentous Sheathes go out for tying down theſe Tendons.

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† Σφυρὸν, ϖίσον, Talus, clavicula, cavilla interior, cavilla domeſtica.

(a) Expoſition anatomique des Os ſecs, Sect. 865.

The Articulations and Motions of the *Tibia* will be explained, after all the three Bones of the Leg are deſcribed.

Both the Ends of the *Tibia* are Cartilages at the Birth, and become afterwards *Epiphyſes*.

*FIBULA* † is the ſmall long Bone, placed on the Outſide of the Leg, oppoſite to the external Angle of the *Tibia*; the Shape of it is irregularly triangular.

The ſuperior Head of the *Fibula* has a ſuperficial circular Cavity formed on its Inſide, which in a recent Subject is covered with a Cartilage, but ſo cloſely connected to the *Tibia* by Ligaments, as to allow only a ſmall Motion backwards and forwards.—— This Head is protuberant and rough on its Outſide, where the *Muſculus Biceps* is inſerted; and below its internal poſterior Side, a Tubercle may be remarked, that gives Riſe to the the ſtrong tendinous Part of the *Solæus* Muſcle.

The Body of this Bone is a little crooked inwards and backwards, which Figure is owing to the Actions of the Muſcles; but is ſtill further increaſed by careleſs Nurſes, who often hold Children by the Legs.——The ſharpeſt Angle of the *Fibula* is forward, on each Side of which, the Bone is conſiderably, but unequally depreſſed by the Bellies of the ſeveral Muſcles that riſe from, or act upon it; and in old People theſe Muſcles make diſtinct Sinuoſities for themſelves: For the poſterior Surface is flatted above by the *Solæus*, and is made hollow below by the *Flexor pollicis longus*.—— The external Surface of this Bone is depreſſed obliquely from above downwards and backwards by the two *Peronæi*; and the anterior Surface bears the Prints of the *Extenſor digitorum longus*, *Nonus Veſalii* and *Extenſor pollicis longus*.—— From the internal Angle the ſtrong Ligament is produced to be continued to the *Tibia*, for the Connexion of theſe two Bones, and for the Origin of ſeveral Muſcles.—— The poſterior Surface is the plaineſt and ſmootheſt: In the Middle of it the Paſſage of the medullary Veſſels is ſeen ſlanting downwards.—— I have been particular in remarking with *Havers* (*a*), the Place of the Entry, and the Direction of theſe Veſſels, becauſe in ſeveral chirurgical Caſes, the Operator ought to regard them, ſince if they are opened very near to their Entry into the Bone, an obſtinate Hæmorrhagy may enſue: For the Arteries being connected to the bony Paſſage, Stypticks and other like Corrugators are vainly applied; compreſſing Inſtruments can do no Service, and Ligatures cannot be employed.—— There ſeems to be a particular Deſign in the Contrivance of theſe Canals, thoſe in the *Os humeri*, *Tibia* and *Fibula*, running obliquely downwards from their external Entry; whereas in the *Radius*, *Ulna*, and *Os femoris*, they ſlant upwards, whereby the Arteries and Nerves which are ſent into theſe three laſt Bones, muſt ſuffer a conſiderable Reflexion before they come at the *Cancelli*.

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† Παρακνήμιον, perone, Focile minus, arundo minor canna minor cruris, ſura, radius.

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(*a*) Oſteolog. nov. Diſc. 1.

The Reaſon of this Diverſity may perhaps be, that the Arteries which are ſo ſmall within the Bones as to have no ſtrong contractile propelling Force in their Coats, and where they are not aſſiſted by the Action of any moving neighbouring Organ, ſhould have, at leaſt in their Paſſage through the Bone, a favourable Deſcent for their Liquids; which, it is evident, they will have in the deſcending oblique Paſſages formed for them in the firſt Claſs of Bones, to wit the *Os humeri*, *Tibia* and *Fibula*, which are generally depending; and they will alſo moſt frequently acquire the like Advantage in the *Radius*, *Ulna*, and *Os femoris*, becauſe the Hand, in the moſt natural Poſture, is higher than the Elbow; and when we ſit or ly, the lower End of the Thigh-bone comes to be at leaſt as high raiſed as the upper. In ſtanding and walking, or when the Arms are moved, the Blood muſt indeed aſcend as it paſſes thro' the Bones of the Fore-arm and Thigh; but the Preſſure of the Muſcles, then in Action, on the Veſſels before they enter the Bones, is ſufficient to compenſate the Diſadvantage of their Courſe. This Reaſoning ſeems to be ſtill enforced by obſerving, that this Paſſage is always nearer the upper than the lower Ends of theſe Bones.

The lower End of the *Fibula* is extended into a ſpongy oblong Head, on the Inſide of which is a convex, irregular, and frequently a ſcabrous Surface, that is received by the external Hollow of the *Tibia*, and ſo firmly joined to it by a very thin intermediate Cartilage and ſtrong Ligaments, that it ſcarce can move.—— Below this, the *Fibula* is ſtretched out into a coronoid Proceſs, that is ſmooth, covered with a Cartilage on its interior Side, and is there contiguous to the Outſide of the firſt Bone of the Foot, the *Aſtragalus*, to ſecure the Articulation on that Side. This Proceſs is named *Malleolus externus*, this Proceſs being ſituated farther back than the internal *Malleolus*, and in an oblique Direction, obliges us naturally to turn the Fore-part of the Foot outwards, as is obſerved by *Winſlow* (*a*). At the lower internal Part of this Proceſs, a ſpungy Cavity for mucilaginous Glands may be remarked; from its Point Ligaments go out to the Foot, and on the back Part of it is a Sinuoſity, made by the Tendons of the *Peronæi* Muſcles.

The Conjunction of the upper End with the *Tibia* is by *Arthrodia*, and at the lower End the Cartilage ſeems to glew the two Bones together, not however ſo firmly in young People, but that the Motion at the other End of ſuch a long *Radius* as the *Fibula*, is very obſervable. —— In old Subjects I often ſee the two Bones of the Leg grown together at their lower Ends.

The principal Uſe of this Bone is to afford Origin and Inſertion to Muſcles, the Direction of which may be a little altered on proper Occaſions, by its upper Part ſhuffling backwards and forwards.— It likewiſe helps to make the Articulation of the Foot more ſecure and firm.

Both the Ends of this Bone are cartilaginous in a ripe Child, and aſſume the Form of *Appendices* before they are united to the Body of the *Fibula*.

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(*a*) Memoires de l'Acad. des Sciences 1722.

*ROTULA* † is the ſmall flat Bone ſituated at the Fore-part of the Joint of the Knee.—— Its Shape reſembles the common Figure of the Heart with its Point downwards.—— The anterior convex Surface of the *Rotula* is pierced by a great Number of Holes, into which Fibres of the ſtrong Ligament that is ſpread over it enter.—— The poſterior Surface is ſmooth, covered with a Cartilage, and divided by a middle convex Ridge into two Cavities, of which the external is largeſt; and both are exactly adapted to the Pulley of the *Os femoris.*—— This plain ſmooth Surface is ſurrounded by a rough prominent Edge, to which the circular Ligament adheres:—— below them, the Point of the Bone is ſcabrous, where the ſtrong tendinous Ligament from the Tubercle of the *Tibia* is fixed.—— The ſuperior horizontal Part of this Bone is flatted and unequal, where the Tendons of the Extenſors of the Leg are inſerted.

The Subſtance of the *Rotula* is cellular, with very thin external firm Plates; but then theſe *Cellulæ* are ſo ſmall, and ſuch a Quantity of Bone is employed in their Formation, that ſcarce any Bone of its Bulk is ſo ſtrong. Beſides, it is covered all over with a thick Ligament, (as it was obſerved that this Sort of Bones generally is,) to connect its Subſtance, and is moveable to one Side or other: and therefore is ſufficiently ſtrong, to reſiſt the Actions of the large Muſcles that are inſerted into it, or any common external Force

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† Ἐπιμυλὶς, μυλακρὶς, κόγχος, ἐπιγονατὶς, πλακουντοειδὲς, patella, mola, genu, ſcuti-forme os, cartilaginoſum, diſciforme, oculus genu.

applied to it; while a fixed Proceſs, ſuch as the *Olecranon*, would not have been ſufficient to bear the whole Weight of our Bodies, which frequently fall on it, and would have hindred the rotatory Motion of the Leg. Notwithſtanding theſe Precautions to preſerve this Bone from ſuch Injuries, yet I have ſeen ſuch another Caſe as *Ruyſch* (a) mentions, to wit, a tranſverſe Fracture in it, when, by the Report of the Patient and People about him, and by the Want of Swelling, Diſcolouring, or other Mark of Bruiſe or Contuſion, it was plain the Bone was broken by the violent ſtraining Effort of the Muſcles. Tho' my Patient recovered the Uſe of the Joint of the Knee, yet I think it reaſonable to believe with *Paré* (b), that this Sort of Fracture ſhould be attended with a Difficulty of Motion, after the broken Parts of the *Rotula* are reunited, becauſe the callous Matter will probably extend itſelf into the Cavity of the Joint, where it may either grow to ſome of the Parts, or at beſt it will make ſuch an Inequality on the poſterior Surface of this Bone, as will not allow it to perform the neceſſary Motions on the Condyles of the *Femur*.

The Articulation of the *Rotula* with the *Os femoris* is a plain *Ginglymus*; and it is connected to the *Tibia* by *Syndeſmoſis*.

At the ordinary Time of Birth, the *Rotula* is entirely cartilaginous, and ſcarcely aſſumes a bony Nature ſo ſoon as moſt *Epiphyſes* do.

The Parts which conſtitute the Joint of the Knee being now deſcribed, let us examine what are its Motions, and how performed.—— The two principal Motions are Flexion and Extenſion.——In the former of theſe, the Leg may be brought to a very acute Angle with the Thigh, by the Condyles of the Thigh-bones being round and made ſmooth ſo far backwards. In performing this, the *Rotula* is pulled down by the *Tibia*.—When the Leg is to be extended, the *Rotula* is drawn upwards, and conſequently the *Tibia* forwards, by the Extenſor Muſcles, which by Means of the protuberant Joint and of this thick Bone with its Ligament, have in effect the Chord, with which they act, fixed to the *Tibia* at a conſiderable Angle, therefore act with Advantage; but are reſtrained from pulling the Leg farther than to a ſtreight Line with the Thigh, by the poſterior croſs Ligament, that the Body might be ſupported by a firm perpendicular Column: For at this Time the Thigh and Leg are as little moveable as if they were one continued Bone.— But when the Joint is a little bended, the *Rotula* is not tightly braced, and the poſterior Ligament is relaxed; therefore this Bone may be moved a little to either Side, or with a ſmall Rotation in the ſuperficial Cavities of the *Tibia*, which *Winſlow* (*a*) juſtly remarks is done by the Motion of the external Cavity backwards and forwards, the internal ſerving as a Sort of Axis. Seeing then one Part of the croſs Ligament is ſituated perpendicularly, and the poſterior Part is ſtretched obliquely from the internal Condyle of the Thigh outwards, that poſterior Part of the croſs Ligament will pre-

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(a) Obſerv. Anat. Chirurg. Obſ. 3.
(b) Liv. 24. chap. 22.

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(*a*) Expoſition Anatomique du corps humain traité des Os ſecs, Sect. 976.

vent the Leg's being turned at all inwards; but it could not hinder it from turning outwards almoſt round, was not that Motion confined by the lateral Ligaments of this Joint, which can yield no great Way. This Rotation of the Leg outwards is of good Advantage to us in croſſing our Legs on ſeveral neceſſary Occaſions, though it is altogether fit this Motion ſhould not be very large, leſt Luxations ſhould frequently have happened here.—— While all theſe Motions are performing, the Part of the *Tibia* that moves immediately on the Condyles is only ſo much as is within the cartilaginous Rings, which by the Thickneſs on their Outſides make the Cavities of the *Tibia* more horizontal, by raiſing their external Side where the Surface of the *Tibia* ſlants downwards. By this Means the Motions of this Joint are more equal and ſteady than otherwiſe they would have been. The Cartilages being capable of changing a little their Situation, are fit for doing this good Office in the different Motions and Poſtures of the Member, and likewiſe contribute to make the Motions larger and quicker.—— Here then is a farther Proof of the general Rule, about moveable interveening Cartilages, laid down in the Deſcription of the lower Jaw.

The *FOOT* is divided, as well as the Hand, into three Parts, viz. *Tarſus*, *Metatarſus* and *Toes*; in the Deſcription of which, the ſeveral Surfaces ſhall be named according to their natural Situation, *viz*. the *Broad* of the Foot ſhall be called ſuperior; the Sole, inferior; the Side on which the Great Toe is, internal; that where the Little Toe is, external.

The *Tarſus* † conſiſts of ſeven ſpongy Bones; of which the *Aſtragalus* is ſuperior, the *Os calcis* poſterior, the *Os naviculare* in the Middle, the *Os cuboides* the external of the four anterior; *Os cuneiforme externum, medium* and *internum*, follow in reckoning inwards.

That the Deſcription of theſe Bones may not be immoderately ſwelled wtih Repetitions, I deſire once for all to obſerve, That wherever a rough Ridge is mentioned, without a particular Uſe aſſigned, a Ligament is underſtood to be fixed to it; or wherever a ſpungy rough Cavity, Depreſſion or *Foſſa* is remarked, without naming its Uſe, a Ligament is inſerted, and mucilaginous Glands are lodged: For ſuch will occur in the Detail of each of theſe Bones.

The upper Part of the *Aſtragalus* * is formed into a large ſmooth Head ‡, which is ſlightly hollowed in the Middle; and therefore reſembles a ſuperficial Pulley, by which it is fitted to the lower End of the *Tibia.*——The internal Side of this Head is flat and ſmooth, to play on the internal *Malleolus.*— The external Side has alſo ſuch a Surface, but larger, for its Articulation with the external *Malleolus.*—— Round the Baſe of this Head there is a rough *Foſſa*; and immediately before the Head, as alſo below its internal ſmooth Surface, we find a conſiderable rough Cavity.

The lower Surface of the *Aſtragalus* is divided by an irregular deep rough *Foſſa*, which

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† Raſſetta.

* Ἀστράγαλος, Talus, baliſtæ os, malleolus, chaib, quatrio, os teſſaræ, claviculæ, nuciforme.

‡ Τετράγωνος.

at its internal End is narrow, but gradually widens, as it ſtretches obliquely outwards and forwards.—— The ſmooth Surface behind this *Foſſa* is large, oblong, extended in the ſame oblique Situation with the *Foſſa*; and concave, for its Conjunction with the *Os calcis.*— The poſterior Edge of this Cavity is produced into two ſharp-pointed rough Proceſſes, between which is a Depreſſion made by the Tendon of the *Flexor pollicis longus.*—— The inferior Surface before the *Foſſa* is convex, and compoſed of three diſtinct ſmooth Plains. The poſterior or longeſt, and the exterior or ſhorteſt, are articulated with the Heel-bone; while the internal, which is the moſt convex of the three, reſts and moves upon a cartilaginous Ligament, that is continued from the *Calcaneum* to the *Os ſcaphoides.* Without which Ligament the *Aſtragalus* could not be ſuſtained, but would be preſſed out of its Place by the great Weight it ſupports, and the other Bones of the *Tarſus* would be ſeparated. Nor would a Bone be fit here, becauſe it muſt have been thicker than could conveniently be allowed; otherwiſe it would break, and would not prove ſuch an eaſy bending Baſe, to leſſen the Shock which is given to the Body in leaping, running, *&c.*

The Fore-part of this Bone is formed into a convex oblong ſmooth Head, which ſome call its Proceſs, which is received by the *Os naviculare.*—Round the Root of this Head, eſpecially on the upper Surface, a rough *Foſſa* may be remarked.

The *Aſtragalus* is articulated above to the *Tibia* and *Fibula*, which together form one Cavity. Tho this Articulation is a *Ginglymus*, it is however ſo looſe, and the Prominencies or Cavities ſo ſmall, as to allow Motions in all Directions. The Flexion and Extenſion are the moſt conſiderable, the other Motions being confined by the *Malleoli*, and by the ſtrong Ligaments which go out from the Points of theſe Proceſſes to the *Aſtralagus*. All the Motions performed at this Joint are more evident in the Fore-part of the Foot, this being the Extremity of the *Radius* of the Circle in which the Motion is made.—— The *Aſtragalus* is alſo joined, below, to the *Os calcis*, by the third Species of *Ginglymus*; and before, to the *Os naviculare*, by *Enarthroſis*.

A conſiderable Share of this Bone is oſſified in a new born Infant.

*Calcaneum* † is the largeſt Bone of the ſeven, ſituated at the inferior and poſterior Part of the *Tarſus*.——Behind, it is formed into a large Knob, commonly called the *Heel*: the poſterior Surface of which is rough where the *Tendo Achillis* is inſerted into it; and above, it is hollow and ſpungy. Farther forwards, on the upper Surface of the *Calcaneum*, is an oblong ſmooth Convexity, adapted to the poſterior Concavity of the *Aſtragalus*: And beyond this irregular Convexity, a narrow *Foſſa* is ſeen, which divides it from two ſmall concave ſmooth Surfaces, that are joined to the Fore-part of the *Aſtragalus*.——Behind the poſterior of theſe ſmooth Surfaces, which is the largeſt, a ſmall Sinuoſity is made by the Tendon of the *Flexor digitorum longus*; at the Fore-part of which a ſmall rough Protuberance appears, that gives Riſe to the *Muſculus extenſor digitorum brevis*.

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† Os calcis, *πτέρνα*, calcar pedis.

The external Side of this Bone is flat, with a ſuperficial *Foſſa* running horizontally, in which the Tendon of the *Muſculus peronæus longus* is lodged.——The internal Side of the Heel-bone is hollowed, for lodging the Origin of the *Maſſa carnea Jac. Sylvii*, and for the ſafe Paſſage of Tendons, Nerves and Arteries.——Under the Side of the internal ſmooth Concavity, a particular Groove is made by the Tendon of the *Flexor pollicis longus*; and from the thin Protuberance on this internal Side, the cartilaginous Ligament that ſupports the *Aſtragalus*, goes out to the *Os naviculare*; on which Ligament, and on the Edge of this Bone to which it is fixed, the Groove is formed for the Tendon of the *Flexor digitorum profundus*.

The inferior Surface of this Bone is preſſed flat at the Back-part, by the Weight of our Bodies; and immediately before this Plain there are two Tubercles, from the internal of which the *Muſculus abductor pollicis*, and *Flexor digitorum ſublimis*, have their Origin; and the *Abductor minimi digiti* riſes from the external.——Before theſe Protuberances this Bone is concave, for lodging the Flexor-muſcles; and at its Fore-part we may obſerve a rough Depreſſion, from which the Ligament goes out that prevents this Bone to be ſeparated from the *Cuboides*.

The anterior Part of the *Os calcis* is formed into an oblong Pulley-like ſmooth Surface, which is circular at its ſuperior external Extremity, but is pointed below. This ſmooth Surface is fitted to the *Os cuboides*.

A large Share of the Heel-bone is oſſified at the ordinary time of Birth, and the large Knob appears afterwards in Form of an *Epiphyſe*.

*Os naviculare* [†], ſituated immediately before the *Aſtragalus*, is ſomewhat circular.——Its poſterior Surface is formed into an oblong Concavity, for receiving the anterior Head of the *Aſtragalus*.——On the ſuperior Surface there is a rough *Foſſa*.——Below, the *Os naviculare* is very unequal and rough, but hollow for the Safety of the Muſcles.——On its Inſide a large Knob riſes out, from which the *Abductor pollicis* takes in part its Origin, and the Tendon of the *Tibialis poſticus* is inſerted into it: And to it two remarkable Ligaments are fixed; the firſt is the ſtrong one formerly mentioned which ſupports the *Aſtragalus*; the ſecond is ſtretched from this Bone obliquely croſs the Foot, to the metatarſal Bones of the middle Toe, and of the Toe next to the little one.——On the Outſide of the *Os naviculare* there is a ſemicircular ſmooth Surface, where it is joined to the *Os cuboides*.——The anterior Surface of this Bone is all covered with a Cartilage, and divided into three ſmooth Plains, fitted to the three *Oſſa cuneiformia*.

The *Os naviculare* is wholly Cartilage in a new-born Infant.

*OS CUBOIDES* [‡] is a very irregular Cube, ſituated immediately before the *Os Calcis*.——The poſterior Surface of this Bone is an oblong unequal Concavity, adapted to the Fore-part of the *Os calcis.*——On its internal Side a very ſmall ſemicircular ſmooth Cavity is formed, to join the *Os naviculare*; immediately before which, an oblong ſmooth Plain is made by the *Os cuneiforme externum*:——Below this, the Bone is hollow and rough.——On the internal Side of the inferior Surface, a round Protuberance and *Foſſa* are found, where the *Adductor pollicis* has its Origin. On the external Side of this ſame Surface, there is a round Knob, covered with a Cartilage; immediately before which, a ſmooth *Foſſa* may be obſerved, in which the Tendon of the *Peronæus primus* runs obliquely croſs the Foot; and on the Knob, the thin flat Cartilage proper to this Muſcle plays; in place of which ſometimes a Bone is found:——More externally than the Knob, a rough Hollow is made, for the ſtrong Ligament ſtretched betwixt this Bone and the *Os calcis.*——The anterior Surface of the *Os cuboides* is flat, ſmooth and ſlightly divided into two Plains, for ſuſtaining the *Os metatarſi* of the Little Toe, and of the Toe next to it.

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[†] Σκαφοειδὴς, Os cymbæ.

[‡] Πολύμορφον, cubiſorme, quadratum, grandinoſum, varium, teſſaræ, multiforme.

The Oſſification of this Bone is ſcarcely begun at the Birth.

*Os cuneiforme externum* †, if we regard its Situation, or *medium* by its Bulk, is much of the Shape of a Wedge, being broad and flat above, with long Sides running obliquely downwards, and terminating in a ſharp Edge.——The ſuperior Surface of this Bone is an oblong Square.——The poſterior is a ſmooth Triangle, which is not complete at the inferior Angle, and is joined to the *Os naviculare*.——The external

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† Chalcoideum externum.

Side is divided as it were by a Diagonal; the ſuperior poſterior Half of which is ſmooth, for its Conjunction with the *Os cuboides*, and the other is a ſcabrous Hollow.——In the ſuperior anterior Angle of this Surface, a ſmall ſmooth Impreſſion is made by the *Os metatarſi* of the Toe next to the Little one.——The internal Side of this Bone has both the anterior and poſterior Edges made flat and ſmooth, the firſt by the *Os metatarſi* of the Toe next to the Great one, and the laſt by the *Os cuneiforme medium.* --The anterior Surface is an oblong Triangle, for ſuſtaining the *Os metatarſi* of the middle Toe.

*Os cuneiforme medium*, or *minimum*, is ſtill more exactly the Shape of a Wedge than the former.——Its internal Side has a flat ſmooth Surface above and behind, for its Conjunction with the following Bone; with a ſmall rough *Foſſa* below; and a conſiderable Share of it is rough and hollow.———The external Side is ſmooth, and a little hollowed, where it is contiguous to the laſt deſcribed Bone.——Both anterior and poſterior Surfaces are flat, ſmooth and triangular for its Articulation with the *Os naviculare* behind, and with the *Os metatarſi* of the Toe next to the Great one before.

*Os cuneiforme maximum*, or *internum*, differs from the two former in its Situation, which is more oblique.——Beſides, the broad thick Part is placed below, and the ſmall thin Point above and outwards; while the inferior broad Surface is concave, for allowing a ſafe Paſſage to the Flexors of the Great Toe.——The poſterior Surface of this *Os cuneiforme* is hollow, ſmooth, and of a circular Figure below, but pointed above.——The external Side is alſo ſmooth and flat, but divided into two, whoſe Direction is nearly at right Angles with each other. With the poſterior, that runs obliquely from below forwards and upwards, the *Os cuneiforme minimum* is joined; and with the anterior, whoſe Direction is longitudinal, the *Os metatarſi* of the Toe next to the Great one is connected.——The anterior Surface of this Bone is ſemilunar, but flat and ſmooth, for ſuſtaining the *Os metatarſi* of the great Toe.——The internal Side is ſcabrous, with two remarkable Tubercles below, from which the *Muſculus abductor pollicis* riſes; and the *Tibialis anticus* is inſerted into its upper Part.

The three cuneiform Bones are all in a cartilaginous State in a *Fœtus* of nine Months.

Theſe ſeven Bones of the *Tarſus*, when joined, are convex above, and leave a Concavity below, for lodging ſafely the ſeveral Muſcles, Tendons and Veſſels that ly in the Sole of the Foot.——In the recent Subject theſe ſuperior and inferior Surfaces are covered with ſtrong Ligaments, which adhere firmly to them, and all the Bones are ſo tightly connected by theſe, and the other Ligaments which are fixed to the rough Ridges and *Foſſæ* mentioned in the preceeding Deſcription of the particular Bones, that, notwithſtanding the many Surfaces covered with Cartilage, ſome of which are of the Form of the very moveable Articulations, no more Motion is here allowed, than only to prevent too great a Shock of the Fabrick of the Body in walking, leaping, &c. by falling on too ſolid a Baſe; which, if it was one continued Bone, would likewiſe be much more liable

able to be broken; and in order to make our Foot accommodate itſelf to the Surfaces we tread on, by becoming more or leſs hollow, or by raiſing either Side of it.—When the Ligaments are too weak, as in ſome morbid Caſes, a very evident Motion of the *Os naviculare* on the *Aſtragalus* may be obſerved.

*METATARSUS* † is compoſed of five Bones, which in their general Characters agree with the metacarpal Bones, but may be diſtinguiſhed from them by the following Marks, 1. They are longer, thicker and ſtronger. 2. Their anterior round Ends are not ſo broad, and are leſs in proportion to their Baſes. 3. Their Bodies are ſharper above, and flatter on the Sides, with their inferior Ridge inclined more to the Outſide. 4. The Tubercles at the inferior Roots of the round Heads are larger.

The firſt or internal metatarſal Bone is eaſily diſtinguiſhed from the reſt by its Thickneſs.—The one next to it is the longeſt, and with its ſharp Edges almoſt perpendicular.——The others are ſhorter and more oblique, as their Situation is more external: Which general Remarks, with the Deſcription I am now to give of each, may teach us to diſtinguiſh what Bone, and to which Foot any one belongs, that can be offered to our Examination.

*Os Metatarſi Pollicis* is by far the thickeſt and ſtrongeſt, as having much the greateſt Weight to ſuſtain. Its Baſe is oblong, irregularly concave, and of a ſemilunar Figure, to be adapted to the *Os cuneiforme maximum.*—The inferior

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† Στῆθος, *πεδίον*. Planta, planum, veſtigium, folium, pectus, præcordium, pectuſculum.

Edge of this Baſe is a little prominent and rough, where the Tendon of the *Peronæus primus* Muſcle is inſerted.—On its Outſide an oblique circular Depreſſion is made by the following Bone.—Its round Head has generally on its Fore-part a middle Ridge, and two oblong Cavities, for the *Oſſa ſeſamoidea*; and on the external Side a Depreſſion is made by the following Bone.

*Os metatarſi* of the ſecond Toe is the longeſt of the five, with a triangular Baſe, ſupported by the *Os cuneiforme medium*, and the external Side produced into a Proceſs, whoſe Extremity is an oblique ſmooth Plain, to be joined to the *Os cuneiforme externum*.—Near the internal Edge of the Baſe this Bone has two ſmall Depreſſions, made by the *Os cuneiforme maximum*, between which is a rough Cavity.—Farther forwards we may obſerve a ſmooth Protuberance, which is joined to the foregoing Bone.—On the Outſide of the Baſe are two oblong ſmooth Surfaces, for its Articulation with the following Bone; the ſuperior ſmooth Surface being extended longitudinally, and the inferior perpendicularly; between which there is a rough *Foſſa*.

*Os metatarſi* of the middle Toe is the ſecond in Length.—Its Baſe, ſuported by the *Os cuneiforme externum*, is triangular, but ſlanting outwards, where it ends in a ſharp-pointed little Proceſs; and the inferior Angle is not completed.

The internal Side of this Baſe is adapted to the preceeding Bone; and the external Side has alſo two ſmooth Surfaces covered with Cartilage, but of a different Figure; for the ſuperior is concave, and being round behind, turns ſmaller as it advances forwards; and the little inferior ſmooth Surface is convex, and very near the Edge of the Baſe.

*Os metatarſi* of the fourth Toe is near as long as the former, with a triangular ſlanting Baſe joined to the *Os cuboides*, and made round at its external Angle, having one hollow ſmooth Surface on the Outſide, where it is preſſed upon by the following Bone, and two on the internal Side, correſponding to the former Bone; behind which, is a long narrow Surface impreſſed by the *Os cuneiforme externum*.

*Os metatarſi* of the little Toe is the ſhorteſt, ſituated with its two flat Sides above and below, and with the Ridges laterally.——The Baſe of it, Part of which reſts on the *Os cuboides*, is very large, tuberous, and produced into a long pointed Proceſs externally; whence Part of the *Abductor minimi digiti* has its Origin; and into its ſuperior Part the *Peronæus ſecundus* is inſerted.——Its Inſide has a flat conoidal Surface, where it is contiguous to the preceeding Bone.

When we ſtand, the anterior Ends of theſe metatarſal Bones, and the *Os calcis*, are our only Supporters, and therefore it is neceſſary, they ſhould be ſtrong, and have ſuch a confined Motion, as they have.

The Bones of the *TOES* are much a-kin to thoſe of the Thumb and Fingers: Particularly the two of the great Toe are preciſely formed as the two laſt of the Thumb; only their Poſition, in reſpect of the other Toes, is not oblique, and they are proportionally much ſtronger, becauſe they are ſubjected to a greater Force;

for

for on thoſe principally the Weight of the Body is ſupported, when we are raiſed on our Tip-toes.

The three Bones in each of the other four Toes differ from thoſe of the Fingers, in theſe Particulars.——They are leſs, and ſmaller in Proportion to their Lengths:——Their Baſes are much larger than their anterior Ends:——Their Bodies are ſharper above and below, and flatter on the Sides.——The firſt *Phalanx* is proportionally much longer than the Bones of the ſecond and third, which are very ſhort.

Of the four, the Toe next to the great one, has the largeſt Bones in all Dimenſions, and more externally the Toes are leſs.——The little Toe, and frequently that next to it, have the ſecond and third Bones intimately united into one, which may be owing to their little Motion, and the great Preſſure they are ſubjected to.

The Toes are of good Uſe to us in Walking; for, when the Sole is raiſed, they bring our Body, with its Center of Gravity perpendicular to the advanced Foot.

The Bones of the *Metatarſus* and Toes, are in the ſame Condition in Children as thoſe of the *Metacarpus* and Fingers.

The only Bones now remaining to complete the Deſcription of the Skeleton, are the ſmall ones, which are found at the Joints of the Fingers and Toes, and in ſome other Parts, called,

*OSSA SESAMOIDEA*, which are of very different Figures and Sizes, tho' they are generally ſaid to reſemble the Seed of the *Seſamum*. ——They ſeem to me nothing elſe than the Ligaments of the Articulations or the firm Tendons of ſtrong Muſcles, or both, become bony, by the violent Compreſſion which they ſuffer. Thus the *Seſamoid* Bones at the Beginning of the *Gaſtrocnemii* Muſcles, are evidently compoſed of the tendinous Fibres only.—— Theſe at the firſt Joint of the great Toe are as plainly the ſame continued Subſtance with the Ligaments and the Tendons of the *Abductor*, *Flexor brevis*, and *Adductor*.——That, which is ſometimes double at the ſecond Joint of that Toe, is Part of the circular Ligament; and if we enumerate the other *Seſamoid* Bones, that are at any time found, we may obſerve all of them formed in this Manner.——Their Number, Figure, Situation and Magnitude are ſo uncertain, that it were in vain to inſiſt on the Differences of each; and therefore, I ſhall only in general remark,

1. That wherever the Tendons and Ligaments are firmeſt, the Actions of the Muſcles ſtrongeſt, and Compreſſion greateſt, there ſuch Bones will be moſt probably found.

2. That, *cæteris paribus*, the older the Subject is in which they are ſought, their Number will be greater, and Size bigger.

3. The more Labour in either, or both Extremities that any Perſon is inured to, he will, *cæteris paribus*, have the moſt numerous and largeſt *Oſſa ſeſamoidea*.

However, as the two at the firſt Joint of the great Toe, are much larger than any other, and are ſeldom wanting in an Adult, we may judge, that beſides the more forcible Cauſe of their Formation, there ſhould alſo be ſome particular Advantage neceſſary at this Place, rather than elſewhere, which may poſſibly be,

to

to allow the *Flexor* Muſcles to ſend their Tendons along this Joint, ſecure from Compreſſion in the Hollow between the two oblong ſeſamoid Bones; while, by removing theſe Tendons from the Center of Motion, and giving them the Advantage of an Angle at their Inſertion, the Force of the Muſcles is increaſed, and therefore the great ſuperincumbent Weight of our Body in Progreſſion is more eaſily raiſed.

# APPENDIX.

## *Of the Marks of a Female Skeleton.*

TO finiſh the Deſcription of the Bones, is generally to conclude the *Oſteology*; but, that no Part of the Subject may be left untouched, I think it neceſſary to ſubjoin the diſtinguiſhing Marks of the Male and Female Skeletons, and have choſen to illuſtrate them in the latter; becauſe Women having a more delicate Conſtitution, and affording Lodging and Nouriſhment to their tender *Fœtuſes*, till they come to have ſufficient Strength and Firmneſs to bear the Injuries of the Atmoſphere, and Contact of other more ſolid Subſtances, their Bones are frequently incomplete, and always of a Make in ſome Parts of the Body different from thoſe of the robuſt Male, which agree to the Deſcription already given, unleſs where the proper Specialities of the Female were particularly remarked, which could not be done in all Places, where they occur, without perplexing the Order of this Treatiſe: Therefore I choſe rather to ſum them up here by Way of *Appendix*.

The Cauſes of the following Specialities of the Female Bones, may be reduced to theſe three. 1. A weak lax Conſtitution. 2. A ſedentary unactive Life, encreaſing that Conſtitution. 3. A proper Frame for being Mothers.

The Bones of Women are ſmaller in Proportion to their Length than thoſe of Men, becauſe the Force of their Muſcles is not ſo great, nor is ſuch ſtrong external Force applied to them to prevent their ſtretching out in Length.

The Depreſſions, Ridges, ſcabrous Surfaces, and other Inequalities made by the Muſcles, are not ſo conſpicuous in them, becauſe their Muſcles are neither ſo thick nor ſtrong, nor ſo much employed to make ſo ſtrong Prints on their Bones.

Their *Os frontis* is more frequently divided by a Continuation of the *ſagittal* Suture, which depends on the firſt and ſecond general Cauſes aſſigned above for the Specialities in their Bones, as will appear after reflecting on the Account given formerly of the middle internal Spine of this Bone.

Their *Clavicles* are leſs crooked, becauſe their Arms have been leſs forcibly pulled forwards, which in our *European* Women, eſpecially thoſe of Diſtinction, is more hindred by their Garb.

Their *Sternum* is more raiſed by long Cartilages below, that the *Thorax* might be there widned in ſome Proportion to what it is ſhortned by the Preſſure upon the *Diaphragm*, when they are with Child.

The Defect of Bone, or the Hole in the Middle of the *Sternum*, is oftneſt found in them, to allow the Paſſage of the Mammary Veſſels, ſay ſome; but, in my Opinion, this is owing to a lax Conſtitution, by which the Oſſification is not ſo ſoon completed, as where the Action of the Solids is vigorous, and the Circulation of the Fluids is briſk; for a much ſmaller Hole might have ſerved this Purpoſe; and the Branches of the internal Mammary Veſſels which are ſent to the exterior Parts of the *Thorax*, paſs out between the Cartilages of the Ribs, before theſe are joined to the *Sternum*.

The *Cartilago Xiphoides*, is oftner bifurcated in Women than Men, for the Reaſon aſſigned in the preceeding Paragraph, *viz.* a leſs forcible Power of Oſſification.

The ſuperior Cartilages of the Ribs ſooner oſſify to ſupport the Weight of the *Mammæ*.

The middle Cartilages are more flat and broad by the Weight of the Breaſts.

The inferior Cartilages are longer for enlarging the Cheſt.

The *Os ſacrum* is broader and turned more outwards for enlarging the *Pelvis*.

Weak Women, who have born many Children when young, often have the *Vertebræ* of their Back bended forwards, and their *Sternum* depreſſed, or become, as *Cheſelden* (*a*) juſtly obſerves, round-ſhouldered and flat-breaſted, by the Preſſure and Weight of the impregnated

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(*a*) Anatomy Book 1. Chap. 3.

gnated *Uterus*, and by the ſtrong Action of the abdominal Muſcles.

The *Os Coccygis* is more moveable, and leſs bended forwards, to facilitate the Birth.

The *Oſſa Iliûm* are more hollow and more reflected outwards, and conſequently further removed from each other, in order to widen the inferior Part of their *Abdomen*, and for the better Support of the impregnated *Uterus*.

The Ridge on the upper Part of the *Os pubis* is larger in ſuch Women as have born Children, being extended by the ſtrong Action of the *Muſculi recti abdominis*.

The Cartilage between the two *Oſſa pubis*, is thicker, by which the *Pelvis* is more capacious.

The conjoined Surfaces of the *Oſſa pubis*, and of the *Oſſa innominata* and *ſacrum* are leſs, that with the ſtreighter *Os ſacrum*, a larger Paſſage might be left for the Excluſion of the Child in Birth.

The great Tuberoſity of the *Oſſa Iſchiûm* is flatter in Women than in Men, becauſe it is more preſſed upon in the ſedentary Life which Females enjoy.

In conſequence of the *Pelvis* of Women being wider, the Articulations of their Thighbones muſt be farther removed from each other; and therefore, as *Albinus* (*a*) very well remarks, a larger Space is left for the Procreation and Birth of Children. Which Diſtance of the Thighs, may be one Reaſon why Women in running generally ſhuffle more from one Side to the other than Men, to preſerve the Center

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(*a*) De Oſſib. Sect. 339.

Center of Gravity of their Bodies from falling too far to a Side of the Joint of the Thigh that ſupports them when the other is raiſed, which would endanger their tumbling to the Ground.

*FINIS.*

IN.

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# THE ANATOMY OF THE *Human Nerves*,

WITH

An Account of the reciprocal
Motions of the HEART,

AND

A Deſcription of the HUMAN
LACTEAL SAC and DUCT.

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The FOURTH Edition.

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*By* ALEXANDER MONRO, *P. A.*

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# PREFACE.

*BEing informed that the following Eſſays have been uſeful to the Students in Anatomy, I have cauſed them to be reprinted with ſuch Amendments as I thought neceſſary.*

*That Offence might not be given, I have treated all the Opinions concerning the diſputed Phyſiology of the Nerves, with that Deference which the Uncertainty of the Subject required, and have not only concealed the Names of the Writers whoſe Sentiments were different from mine, but have ſhun'd Quotations from thoſe whom I approve, leſt the Knowledge of the latter ſhould be a Key to diſcover the former by.*

*Deſcriptions of the very minute Ramifications of the Nerves are obſcure to the young Gentlemen for whoſe Uſe I write, and therefore I have taken Notice only of the larger Branches in the Deſcription of the particular Nerves.*

*I have endeavoured to illuſtrate my great Maſter Dr.* Boerhaave's *Doctrine in the Account*

*count here given of the* Syſtole *and* Diaſtole *of the Heart.*

*The Deſcription of the* Receptaculum chyli *and* thoracick Duct *is more accurate than in the common Syſtems of Anatomy, and on that account is here republiſhed.*

*The Corrections and Additions made in this Edition of the Anatomy of the Bones, and of theſe Eſſays, ſhew that my own Errors and Omiſſions are rather too great a Burthen for me to ſtruggle with, it is cruel to load me with a great Number more, and many of them ſuch as the youngeſt Pupil under my Care would be aſhamed of. I muſt therefore beg the Publick to impute no more Faults to me as an Author than what are contained in the preceeding Anatomy of the Bones, in the following Eſſays, and in thoſe Papers of the five Volumes of Medical Eſſays and Obſervations to which my Name is prefixed.*

# THE
# ANATOMY
# OF THE
# *Human Nerves.*

---

## *Of the Nerves in general.*

1. BY the Aſſiſtance of Injections and Microſcopes wonderful Plexuſes of Blood-veſſels are diſcovered to go from the *Pia Mater* into the *Cortex*, cineritious, or aſhy-coloured Part of the *Cerebrum*, *Cerebellum* and *ſpinal Marrow*, whereas we can only ſee longitudinal Veſſels, without numerous Ramifications or reticular Plexuſes, in the white medullary Subſtance of theſe Parts.

2. The Continuity of the *Cortex* with the *Medulla* of the *Encephalon* and *ſpinal Marrow* is obſervable with the naked Eye, and is more diſtinctly ſeen with the Aſſiſtance of a Microſcope.

3. In diſſecting the *Brain* and *Cerebellum*, we ſee the ſmall Beginnings of the *Medulla* proceeding from the *Cortex*, and can trace its gradual Increaſe by the Addition of more *Medulla* coming from the *Cortex*.

4. Both *Cortex* and *Medulla* are very ſucculent; for being expoſed to the Air to dry, they loſe more of their Weight than moſt other Parts of the Body do.

5. In ſeveral Places we can obſerve the *Medulla* to be compoſed of Fibres laid at each others Sides.

6. The medullary Subſtance is all employed in forming the white fibrous Cords, which have now the Name of *Nerves* appropriated to them. Within the Skull we ſee the Nerves to be the medullary Subſtance continued, and the *medulla ſpinalis* is all employed in forming Nerves.

7. The common Opinion concerning the Riſe of the Nerves, founded on a ſuperficial Inſpection of thoſe Parts, is, that the Nerves are propagated from that Side of the *Encephalon*, at which they go out of the Skull. But it having been remarked, after a more ſtrict Enquiry, and preparing the Parts by Maceration in Water, that the medullary Fibres decuſſate or croſs each other in ſome Parts of the *Medulla*; as for Example, at the *Corpus annulare*, and Beginning of the *Medulla ſpinalis*: And practical Obſervators having related ſeveral Examples of People, whoſe Brain was hurt on one Side, while the morbid Symptom, Palſy, appeared on the other Side of the Body, of which I have ſeen two Inſtances; and Experiments made on Brutes having confirmed theſe

Obſervations, it has been thought, that the Nerves had their Riſe from that Side of the *Encephalon*, which is oppoſite to their Egreſs from the Skull. It may however ſtill be ſaid, that this laſt Opinion is not fully demonſtrated, becauſe a Decuſſation in ſome Parts is not a Proof that it obtains univerſally; and if there are Examples of Palſy of the Side oppoſite to where the Leſion of the Brain was, there are alſo others, where the Injury done to the Brain and the Palſy were both on the ſame Side.

8. The Nerves are compoſed of a great many Threads lying parallel to each other at their Exit from the *Medulla*.

This fibrous Texture is evident at the Origin of moſt of the Nerves within the Skull; and in the *Cauda equina* of the *Medulla ſpinalis*, we can divide them into ſuch ſmall Threads, that a very good Eye can ſcarce perceive them; but theſe Threads, when looked at with a Microſcope, appear each to be compoſed of a great Number of ſmaller Threads.

9. How ſmall one of theſe Fibrils of the Nerves is we know not, but when we conſider that every, even the moſt minute Part of the Body is ſenſible, and that this muſt depend on the Nerves (which all conjoined, would not make a Cord of an Inch Diameter) being divided into Branches or Filaments to be diſperſed through all theſe minute Parts, we muſt be convinced that the nervous Fibrils are very ſmall. From the Examination of the *minimum viſibile* it is demonſtrated, that each Fibre in the *Retina* of the Eye, or expanded optick Nerve, cannot exceed the Size of the 32400 Part of a Hair.

10. The medullary Subſtance, of which the nervous Fibrils are compoſed, is very tender, and would not be able to reſiſt ſuch Forces as the Nerves are expoſed to within the Bones, nor even the common Force of the circulating Fluids, were not the *Pia mater* and *Tunica Arachnoides* continued upon them. The former giving them Firmneſs and Strength, and the latter furniſhing a cellular Coat to connect the Threads of the Nerves, to let them ly ſoft and moiſt, and to ſupport the Veſſels which go with them.

It is this cellular Subſtance that is diſtended with Air, when forced through a Blow-pipe thruſt into a Nerve, and that makes a Nerve appear all ſpungy, after being ſo diſtended till it dries, the proper nervous Fibrils ſhrivelling ſo in drying, that they ſcarce can be obſerved.

11. Theſe Coats, (§ 10.) would not make the Nerves ſtrong enough to bear the ſtretching and Preſſure they are expoſed to in their Courſe to the different Parts of the Body; and therefore where the Nerves go out at the Holes in the *Cranium* and *Spine*, the *Dura Mater* is cloſely wrapt round them, to collect their diſgregated Fibres into tight firm Cords; and that the Tenſion, which they may happen to be expoſed to, may not injure them, where they have not this additional Coat, this ſtrong Membrane is firmly fixed to the Sides of the Holes in the Bones through which they paſs.

12. The nervous Cords thus compoſed of nervous Fibrils, cellular Coat, *Pia* and *Dura Mater*, have ſuch numerous Blood-veſſels beſtowed on them, that after their Arteries only

are injected, the whole Cord is tinged of the Colour of the injected Liquor; and if the Injection is puſhed too violently, the cellular Subſtance of the Nerves comes to be diſtended with it.

13. A nervous Cord, ſuch as has been juſt now deſcribed, (§ 12.) has very little Elaſticity, compared with ſeveral other Parts of the Body. When cut out of the Body, it does not become obſervably ſhorter, while the Blood-veſſels contract three Eighths of their Length.

14. The Nerves in their Courſe to the ſeveral Parts of the Body, are generally lodged in a cellular or fatty Subſtance, and run in the Interſtices of the Muſcles and other active Organs. Thus they are carefully guarded from the Preſſure of theſe Parts, and the conſequent bad Effects of ſuch Preſſure is prevented.

15. The larger Cords of the Nerves divide into Branches as they go off to the different Parts; the Branches being ſmaller than the Trunk from which they come, and making generally an acute Angle where they ſeparate.

16. In ſeveral Places different Nerves unite into one Cord, which is commonly larger than any of the Nerves which form it.

17. Several Nerves, particularly thoſe which are diſtributed to the Bowels, after ſuch Union (§ 16.) ſuddenly form a hard Knot, conſiderably larger than all the Nerves of which it is made. Theſe Knots were called *Corpora olivaria*, and are now generally named *Ganglions*.

18. The *Ganglions* have thicker Coats, more numerous and larger Blood-veſſels than

the Nerves, ſo that they appear more red and muſcular. On diſſecting the *Ganglions*, Fibres are ſeen running longitudinally in their Axes, and other Fibres are derived from their Sides in an oblique Direction to the longitudinal ones.

19. The Nerves which go out from the *Ganglions* are no way remarkably different from other Nerves.

20. The Nerves ſent to the Organs of the Senſes loſe there their firm Coats, and terminate in a pulpy Subſtance. The *optick Nerves* are expanded into the ſoft tender Webs the *Retinæ*; the *auditory Nerve* has ſcarce the Conſiſtence of *Mucus* in the *Veſtibulum*, *Cochlea* and *ſemicircular Canals* of each Ear; the *Papillæ* of the Noſe, Tongue and Skin are very ſoft.

21. The Nerves of Muſcles can likewiſe be traced till they loſe their Coats and become very ſoft, from which, and what we obſerved of the ſenſatory Nerves, (§ 20.) there is Reaſon to conclude, that the muſcular Nerves are alſo pulpy at their Terminations, which we cannot indeed proſecute by Diſſection.

22. It would ſeem neceſſary that the Extremities of the Nerves ſhould continue in this ſoft flexible State, (§ 20, 21.) in order to perform their Functions right: For in proportion as Parts become rigid and firm by Age, or any other Cauſe, they loſe of their Senſibility, and the Motions are more difficultly performed.

23. Tho' the Fibres in a nervous Cord are firmly connected, and frequently different Nerves join into one Trunk, or into the ſame *Ganglion*, yet the Senſation of each Part of the

Body is ſo very diſtinct, and we have ſo much the Power of moving the Muſcles ſeparately, that, if the Nerves are principal Agents in theſe two Functions, which I ſhall endeavour to prove they are, we have Reaſon to believe that there is no Union, Confuſion or immediate Communication of the proper nervous Fibrils, but that each Fibre remains diſtinct from its Origin to its Termination.

24. Changes produced any way upon the Coats of the Nerves cannot however miſs to affect the nervous Fibrils. The cellular Subſtance may be too full of Liquor or may not ſupply enough; the Liquor may not be of a due Conſiſtence, or it may be preternaturally obſtructed and collected. The *Pia Mater* may be too tenſe or too lax, as may alſo the *Dura Mater*; their Veſſels may be obſtructed; their proper Nerves may be violently irritated or loſe their Power of acting; and a great many other ſuch Changes may happen which will not only occaſion Diſorders in particular Nerves, but may cauſe the *Sympathy* ſo frequently obſerved among the Nerves, which is ſo neceſſary to be attentively regarded in a great many Diſeaſes in order to diſcover their true State and Nature, without the Knowledge of which we muſt commit very dangerous Miſtakes in the Practice of Phyſick and Surgery.

25. Many Experiments and Obſervations concur in proving, that when Nerves are compreſſed, cut, or any other way deſtroyed, the Parts ſerved by ſuch Nerves farther from the Head or Spine than where the injuring Cauſe has been applied have their Senſations, Motions and Nouriſhment weakned or loſt, while

no ſuch Effects are ſeen in the Parts nearer to the Origin of thoſe Nerves; and in ſuch Experiments where the Cauſe impeding the Nerves to exert themſelves could be removed, and the Structure of the Nerves not injured; as for Example, when a Ligature made upon a Nerve and ſtopping its Influence has been taken away, the Motion and Senſation of the Parts ſoon were reſtored. From which it would appear that the Nerves are *principal* Inſtruments in our Senſations, Motions and Nouriſhment; and that this Influence of the Nerves is not inherent in them without the Communication between theſe Cords, and their Origin is preſerved.

It will be no Objection to this Concluſion, that ſometimes, upon cutting a Nerve, the Effects above-mentioned have been felt for a ſhort time, but afterwards the Perſon was ſenſible of no Numneſs or Immobility; for wherever this is ſaid to have happened, the cut Nerve was only one of ſeveral which were ſent to the Member, the want of whoſe Influence was felt no longer than till the Habit was acquired of performing the Functions eaſily by the other Nerves.

It is of no greater Weight as an Objection, that when a Ligature is drawn very hard upon a Nerve, the Nerve never again recovers its Influence upon the Parts it is diſtributed to beyond the Ligature, but is of as little Effect as if it had been cut thro'; which is to ſay, that its Texture has been alter'd beyond Recovery. The ſame Thing is to be ſeen by tying a Thread tight round a tender Twig of any Vegetable, it decays.

26. Experiments and Obſervations ſhew too,

that when Parts of the *Encephalon* or *Medulla ſpinalis* have been irritated, compreſſed or deſtroyed, the Parts of the Body, whoſe Nerves had their Origin from ſuch affected Parts of the *Encephalon* or *Medulla ſpinalis*, became convulſed, paralytick, inſenſible or waſted; and in ſuch Caſes where the injuring Cauſe could be removed from the Origin of the Nerves, the morbid Symptoms obſerved in the Parts to which theſe Nerves were diſtributed, went off upon the Removal of that Cauſe. From which it is thought reaſonable to conclude, that the Nerves muſt not only have a Communication with their Origin, but that the Influence they have upon the Parts they are diſtributed to, depends on the Influence which they derive from the *Medulla Encephali* and *ſpinalis*.

27. Tho' the *Medulla ſpinalis* has its own Veſſels and cineritious Subſtance which aſſiſts to form its *Medulla*, yet a very large Share of the medullary Subſtance within the Spine is derived from the *Encephalon*, whoſe *Medulla oblongata* deſcends from the Head, and the Influence of the *Medulla ſpinalis* on its Nerves depends in a great Meaſure on this *Medulla oblongata* of the Head. Hence an Injury done to any Part of the *Medulla ſpinalis* immediately affects all the Parts whoſe Nerves have their Origin below where the injuring Cauſe is applied to the Spinal Marrow. A Luxation of a *Vertebra* in the Loins makes the lower Extremities ſoon paralytick; a tranſverſe Section of the *Medulla* at the firſt *Vertebra* of the Neck ſoon puts an End to Life.

28. If ſuch Cauſes produce conſtantly ſuch Effects (§ 25, 26, 27.) in us and other Crea-

tures living in nearly the ſame Circumſtances as we do, the Concluſions already made will be good, notwithſtanding Examples of Children and other Creatures being born without *Brains* or *Medulla ſpinalis*; or notwithſtanding the Brains of adult Creatures being much changed in their Texture by Diſeaſes, and notwithſtanding *Tortoiſes*, and ſome other Animals, continued to move about a conſiderable time after their Heads were off. We may be ignorant of the particular Circumſtances requiſite or neceſſary to the Being or Wellbeing of this or that particular Creature, and we may be unable to account for a great many *Phænomena*; but we muſt believe our Eyes in the Examination of Facts, and if we ſee conſtantly ſuch Conſequences from ſuch Actions, we cannot but conclude the one to be the Cauſe, and the other the Effect. It would be as unjuſt to deny the Concluſions made in the three preceeding Articles, becauſe of the ſeemingly preternatural Phænomena mentioned in the Beginning of this Article, as it would be to deny the Neceſſity of the Circulation of the Blood in us and Quadrupeds, becauſe a Frog can jump about or a Tortoiſe can walk long after all the Bowels of its Thorax and Abdomen are taken out, or becauſe the different Parts of a Worm crawl after it has been cut into a great many Pieces. It is therefore almoſt univerſally agreed that the Nerves are principal Inſtruments in our Senſations, Motion and Nouriſhment, and that the Influence which they have is communicated from their Origin, the *Encephalon* and *Medulla ſpinalis*; but Authors are far from agreeing about the Manner in which this Influence is communicated, or in what Way Nerves act to produce theſe Effects.

29. Some alledge that *the nervous Fibres are all ſolid Cords acting by Elaſticity or Vibration.* Others affirm that *thoſe Fibres are ſmall Pipes conveying Liquors, by means of which all their Effects are produced.*

30. The Gentlemen, who think the nervous Fibres ſolid, raiſe ſeveral Objections to the other Doctrine, which I ſhall conſider afterwards, and endeavour to ſhew the Fitneſs of their own Doctrine to account for the Effects commonly obſerved to be produced by the Nerves.

The Objects of the Senſes plainly, ſay they, make Impulſes on the Nerves of the proper Organs, which muſt ſhake the nervous Fibrils, and this Vibration muſt be propagated along the whole Cord to its other Extremity or Origin, as happens in other tenſe Strings; and theſe Vibrations being differently modified according to the Difference of the Object, and its different Application, produce the different Ideas we have of Objects.

31. To this Account of the Senſations it is objected, 1*ſt*, That Nerves are unfit for Vibrations, becauſe their Extremities, where Objects are applied to them, are quite ſoft and pappy, (§ 20.) and not ſuſceptible of the Vibrations ſuppoſed; and if there could be any little Tremor made here by the Impulſe of Objects, it could not be continued along the nervous Cord, becauſe the cellular Subſtance by which each particular Fibre is connected to the neighbouring ones, (§ 10.) and the fatty Subſtance in which the nervous Cord is im-

merſed (§ 14.) would ſoon ſtifle any ſuch vibratory Motion.

The 2*d* Objection to this Doctrine is, that, ſuppoſing the Nerves capable of Vibrations by the Impreſſions of Objects, theſe Vibrations would not anſwer the Deſign. For if what we know of other vibrating Strings, to wit, that their Tone remains the ſame, unleſs their Texture, Length or Tenſion is altered, and that different Subſtances ſtriking them do no more than make the Sound higher or lower: If theſe Properties are to be applied to Nerves, then it will follow that the ſame Nerve would conſtantly convey the ſame Idea, with no other Variety than of its being weaker or ſtronger, whatever different Objects were applied to it, unleſs we ſuppoſe the Nerve changed in its Texture, Length or Tenſion each time a different Object is applied, which, it is preſumed, no Body will undertake to prove does happen. But further, if ever ſuch a Variety of Vibrations could be made, our Senſations would notwithſtanding be confuſed and indiſtinct, becauſe the tremulous nervous Fibre being firmly connected, and contiguous to ſeveral other Fibres of the ſame Cord, would neceſſarily ſhake them too, by which we ſhould have the Notion of the Object as applied at all the different Parts where the Extremities of theſe Fibres terminate.

32. In whatever way the Favourers of the Doctrine of ſolid Nerves pleaſe to apply the Elaſticity of Nerves to the Contraction of Muſcles; their Adverſaries inſiſt that Nerves are too weak to reſiſt ſuch Weights as the Muſcles ſuſtain, they would ſurely break, eſpecially as

they are in a great meaſure, if not wholly, deprived of their ſtrong Coats before they come to the Part of the Muſcle they are immediately to act upon, (§ 21.) and the Nerves being found to have little or no Elaſticity to ſhorten themſelves, (§ 12.) ſhews them altogether unfit for ſuch an Office as this of contracting Muſcles in the way propoſed of their acting by Elaſticity.

33. As a further Objection againſt either Motion or Senſation being owing to the Elaſticity of the Nerves, it is ſaid, that if this Doctrine was true, the Senſations would be more acute, and the Contractions of Muſcles would be greater and ſtronger, when the Parts become firmer and more rigid by Age; for then their Elaſticity is increaſed: Whereas on the contrary it appears, (§ 22.) that then the Senſations are blunted, and muſcular Contraction becomes leſs and weaker.

34. If the Nerves were granted to be elaſtic, and to communicate a ſpringy Force to all the Parts they are diſtributed to, they might appear neceſſary in this View to aſſiſt the Application of the nutritious Particles of the Fluids to the Sides of the Veſſels which theſe Particles were to repair, and ſo far might well enough account for the Share which Nerves are thought to have in Nutrition; yet if we cannot make uſe of Elaſticity in the other two Functions of Senſation and Motion, we muſt alſo endeavour to find out ſome other Way for the Nerves to act in Nutrition, which will be done afterwards.

35. Having thus ſtated the Reaſons for and againſt the Nerves acting as ſolid Strings, let us likewiſe relate the Arguments for Nerves

being Pipes, and the Objections to this Doctrine.

A great Argument of thoſe who think the Nerves to be Tubes conveying Liquors, is the ſtrong Analogy of the Brain and Nerves to other Glands of the Body and their Excretories, where a manifeſt Secretion of Liquor is made in the Glands to be conveyed by the Excretories, to the proper Places in which it ought to be depoſited: They think that the vaſcular Texture of the *Cortex* of the *Encephalon* and *Medulla ſpinalis* (§ 1.); the Continuation of the *Cortex* in forming the medullary Subſtance (§ 2. 3.), the fibrous Texture (§ 5.) and ſucculent State of this *Medulla* (§ 4.), and its being wholly employed to form the Nerves, (§ 6.) where the fibrous Texture is evident (§ 8.); all theſe Things, ſay they, conſpire to ſhew ſuch a ſtrong Analogy between theſe Parts and the other Glands of the Body, as carries a Conviction that there is a Liquor ſecreted in the *Encephalon* and *Medulla ſpinalis*, to be ſent out by the Nerves to the different Parts of the Body.

36. The following Objections are raiſed to this Argument in Favour of a Liquor conveyed in the Nerves, from the Analogy of the Glands. 1*ſt*, Other Glands, it is ſaid, have their Excretories collected into a few large Pipes, and not continued in ſuch a great Number of ſeparate Pipes, as far as the Places where the Liquors are depoſited, which laſt muſt be the Caſe, if the Nerves are the Excretories of the glandular Brain. 2*dly*, We ſee the Cavities and can examine the Liquors in the Excretories of other Glands much ſmal-

ler than the Brain, which cannot be done in the Nerves. *3dly*, If the Nerves were Pipes, they would be ſo ſmall that the Attraction of the Liquors to their Sides, would prevent that Celerity in the Motion of the Liquors, which is requiſite to Senſations and Motions. *4thly*, If the Nerves were Pipes they would be cylindrical ones, and conſequently not ſubject to Diſeaſes, or at leaſt we could have no Comprehenſion of the Diſeaſes in them.

37. The Anſwer to the *1ſt* of theſe Objections is, That there are other Glands where there is a manifeſt Secretion, and in which the Diſpoſition of the Excretories is in much the ſame Way as in the *Encephalon*; the Kidneys, for Example, have a reticulated *Cortex* of Veſſels, from which the *Euſtachian* or *Bellinian Medulla*, conſiſting of longitudinal Fibres and a few Blood Veſſels in the ſame Direction proceeds; and this *Medulla* is collected into ten or twelve *Papillæ*, each of which is formed of numerous ſmall ſeparate Pipes, which ſingly diſcharge the Urine into the large membranous Tubes, and theſe united form the *Pelvis*. Upon comparing this Texture of the Kidney with that of the *Encephalon*, (§ 1, 2, 3, 4, 5, 6, 8.) the Analogy will be found very ſtrong.

38. In Anſwer to the *2d* Objection in § 36. it is granted, that Microſcopes, Injections, and all the other Arts hitherto employed have not ſhewn the Cavities of the nervous Fibrils, or the Liquors contained in them; and from what was ſaid (§ 9.) of the Smallneſs of the nervous Fibrils, it is not to be expected that ever they ſhould be ſeen. But ſo long as ſuch

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a Number of little Animals can every Hour be brought to the Objectors, in which they can as little demonſtrate the Veſſels or contained Fluids, it will not be allowed to be concluſive Reaſoning, that becauſe ocular Demonſtration cannot be given of either Tubes or their Contents, therefore they do not exiſt. For if we have any Notion of an Animal, it is its being an Hydraulick Machine, which has Liquors moving in it as long as it has Life; if therefore ſuch little Animals have Veſſels and Liquors which we cannot ſee, why may not ſome of the Veſſels and Liquors of the human Body be alſo inviſible to us.

To avoid this Anſwer to the Objection, it is further urged that tho' we might not ſee the nervous Tubes or the Liquors they contain, as they naturally flow, yet if ſuch Liquors really exiſt, they ought to diſcover themſelves, either by a Nerve's ſwelling when it is firmly tied; or that however ſubtile their Fluids are, they might be collected in ſome Drops at leaſt, when the cut End of a Nerve of a living Animal is kept ſome Time in the exhauſted Receiver of an Air-Pump. It is affirmed, that neither did the tied Nerve ſwell between the Brain and Ligature, nor was there any Liquor collected in the Receiver of the Air-Pump, from which it is concluded that there is no Liquor in the Nerves.

There is ſome Difference among thoſe who ſay they have tried theſe Experiments, ſome affirming that in young Animals the Nerve does ſwell above the Ligature, and that a Liquor does drill out upon cutting a Nerve. But allowing the Experiments to ſucceed any way, the Reply to the Inference from them is, that in neither way are they any thing to the Purpoſe; for the ſwelling of the Nerve after it is tied, or the Efflux of Liquors from its Extremity, will never prove either to be the Effect of the Fluid in the proper nervous Fibrils, ſo long as they might be occaſioned by the Liquors in the larger Veſſels of the cellular Subſtance of the Nerves; and if theſe ſame Veſſels of the Coats of the Nerves do not diſcover their Liquors by theſe Experiments, it is far leſs to be expected, that the much more ſubtile Nerves ſhould.

39. The 3*d* Objection to the Doctrine of the Brain being a Gland, and the Nerves its Excretories, ſuppoſes a more rapid Motion neceſſary in the Fluid of the Nerves, than what moſt of the Defenders of the nervous Fluid will now allow, and is afterwards to be conſidered particularly in a more proper Place.

40. The 4*th* Objection being, that if Nerves are Excretories of a Gland, they muſt be cylindrical Pipes, in which no Obſtructions or Diſeaſes would happen; but ſince we daily ſee Diſeaſes in the Nerves, they muſt therefore not be ſuch Excretories. The Anſwer is, That Diſeaſes happen often in the Excretories of other Glands, as of the Liver, Kidneys, *&c.* notwithſtanding their cylindrical Form, and their much ſhorter and leſs expoſed Courſe. When we conſider the very tender Subſtance of the Brain; the vaſt Complication of Veſſels there; the prodigious Smallneſs of the Pipes going out from it; the many moving Powers which the Nerves are to undergo the Shock of; and the many Chances which the Veſſels,

Membranes and cellular Subſtance accompanying the Nerves have of being diſordered, and then affecting the nervous Fibrils, we have very great Reaſon to be ſurprized, that theſe cylindrical Pipes are not much more frequently put out of Order by too great or too ſmall a Quantity of Liquors; by too viſcid or too thin Fluids; by Liquors conſiſting of too mild and ſluggiſh Particles, or of too acrid pungent ones; by too great or too little Motion given to the Liquors; by the Diameters of the Pipes being too much ſtraitned, or too much enlarged; and by a great many other Varieties of Circumſtances which might be ſuppoſed, capable of diſturbing the Functions of the Nerves, ſuppoſing them to be cylindrical Excretories of the Gland the Brain.

41. The numerous Veſſels of the *Encephalon* have brought ſome of the Gentlemen who aſſert the Nerves to be ſolid, to acknowledge, that there is a Liquor ſecreted in the Brain; but then they will not allow that this Liquor is ſent out by the proper nervous Fibrils, but that it is poured into the cellular Subſtance in which the Nerves ly, to keep them moiſt and ſupple, and therefore fit for exerting their Elaſticity, Vibration, &c. by which, in their Opinion, the Effects, commonly aſcribed to Nerves, are produced.

42. Beſides the Objections already mentioned (§ 31, 32.) againſt the Nerves acting as elaſtick Strings, this Opinion has ſome other Difficulties which may be objected to it: For inſtance, there is not one analogous Example in the whole Body of Liquors ſecreted in a large Gland to be poured into a cellular Subſtance,

ſtance, as is here ſuppoſed; the Liquors in the Cells of the *tunica cellularis* of other Parts are ſeparated from the little Arteries which are diſtributed to theſe Cells.

Further, it can't be well determined, how a Liquor ſecreted in the *Cortex* of the Brain ſhould make its Way through the *Medulla* to come out into the cellular Membranes on the Surface of that *Medulla*.

*Laſtly*, A very ſimple Experiment of injecting Water by the Artery of any Member, and thereby filling the cellular Subſtance of the Nerves of that Member, ſhews evidently that the Liquor of the *tunica cellularis* of the Nerves has the ſame Fountain as the Liquor in the *tunica cellularis* has any where elſe, that is, from the little Arteries diſperſed upon it.

43. The Doctrine of a Fluid in the Nerves is not only thus ſupported by the Analogy of the Brain and Nerves to the other Glands and their Excretories; but thoſe who maintain this Doctrine mention an Experiment which they think directly proves a Fluid in the Nerves, it is this. After opening the Thorax of a living Dog, catch hold of and preſs one or both the phrenic Nerves with the Fingers, the *Diaphragm* immediately ceaſes to contract; ceaſe to compreſs the Nerves, and the Muſcle acts again: A ſecond Time lay hold of the Nerve or Nerves ſome way above the *Diaphragm*, its Motion ſtops. Keep firm the Hold of the Nerve, and with the Fingers of the other Hand ſtrip it down, from the Fingers which make the Compreſſion, towards the *Diaphragm*, and it again contracts; a Repetition of this Part of the Experiment three or four Times, is al-

ways attended with the ſame Effects, but it then contracts no more, ſtrip as you will, unleſs you remove the Preſſure to take hold of the Nerves above the Place firſt pinched, when the Muſcle may again be made to contract by ſtripping the Nerve down towards it. This Experiment I have done with the Succeſs here mentioned. Let any one try if he can imagine any other reaſonable Account of theſe Appearances, than that the Preſſure by the Fingers ſtopp'd the Courſe of a Fluid in the Nerve: That ſo much of this Fluid as remained in the Nerve, betwixt the Fingers and *Diaphragm*, was forced into that Muſcle by ſtripping, and when it was all preſſed away, the Fingers above preventing a Supply, the Muſcle contracted no more till the Fingers were removed, and a freſh Flow by that Means was received from the ſpinal Marrow, or from that Part of the Nerve, which had not yet been ſo ſtripped.

44. Some Gentlemen convinced of the Reaſonableneſs of the Secretion of a Liquor in the Brain to be ſent out by the Nerves, but not comprehending how a Fluid could have ſuch a rapid retrograde Motion as they imagined was neceſſary for conveying the Impreſſions of Objects made on the Extremities of Nerves to the *Senſorium*, ſuppoſed two Sorts of Nerves, one that conveyed a Liquor for muſcular Motion and Nutrition, the other compoſed of ſolid Nerves, that were to ſerve for the Organs of the Senſes, to convey the Vibrations communicated from Objects to the *Senſorium*.

45. To this Opinion (§ 44) the Objections againſt the ſenſatory Nerves acting by Vibration (§ 31) may be made, and there is ſo little Rea-

ſon to ſuſpect any Difference in the Texture of the Brain or Nerves, that on the contrary the Structure is every where ſimilar, and Branches of the ſame Nerve often ſerve both for Senſation and Motion.

How little Neceſſity there is for ſuppoſing extremely rapid Motions of the nervous Fluid, is to be examined ſoon, (§ 57, 58).

46. The Hypotheſis of great Celerity in the Motion of the Fluid of the Nerves being neceſſary, gave alſo Riſe to another Diviſion of the Nerves, into *arterious* or *effluent* and *venous* or *refluent*. It was ſaid, that muſcular Motion and Nutrition depended on the arterious Nerves, and that the Senſations depended on an accelerated Motion of the nervous Fluid towards the Brain, by the Impreſſions which the Objects of the Senſes make upon the venous Nerves. By this Suppoſition the Abſurdity of rapid Fluxes and Refluxes in the ſame Canal was prevented, and an Advantage was thought to be gained by it, of ſaving too great a Waſte of the Fluid of the Nerves, which otherwiſe the *Encephalon* and *Medulla ſpinalis* could not ſupply in ſufficient Quantity to anſwer all the Exigencies of Life.

47. To this Opinion (§ 46.) it has been objected, 1. That there is no Example in the Body of a ſecreted Liquor being returned immediately and unmixed to the Gland by which it was originally ſeparated from the Maſs of Blood, which would be the Caſe were there venous Nerves. 2*dly*, There is no Occaſion for ſaving the Fluid of the Nerves in the Way propoſed, the Organs for ſecreting that Fluid being large enough to ſupply all that is neceſ-

ſary of it in the common Functions of Life. 3*dly*, If the Fluid of the Nerves was to be thus kept in a perpetual Circulation, it would ſoon become too acrid for continuing with Safety in ſuch ſenſible tender Veſſels as the Brain and Nerves are compoſed of. 4*thly*, This Hypotheſis will not anſwer the Deſign for which it was propoſed. For tho' the momentary Application of an Object might cauſe an Acceleration in the Fluid of venous Nerves, yet if the Object was kept applied to the Nerves, it would ſtop their Fluid, ſo that it could not go forward to the Brain; and therefore according to this Doctrine, we ſhould be ſenſible of no Objects, except thoſe whoſe Application to the Organs of the Senſes was momentary.

48. Let us now ſuppoſe it probable, that the *Encephalon* and *Medulla ſpinalis* ſecern a Liquor from the Blood which is ſent into all the Nerves, and that by the Means of this Liquor the Nerves perform the Offices commonly aſſigned to them, it is next neceſſary to enquire what Kind of Liquor this is, and how it moves, in order to determine how well its Nature and Motion are fitted for performing what is expected from it.

49. The Liquor of the Nerves has been fancied by ſome to be of a very ſtrong acid or alcaline Nature; but ſince none of our Juices appear to be of this Sort, and ſince ſuch Liquors irritate and deſtroy the Parts of the Body which they are applied to, we cannot conceive how the Brain can ſeparate, or the Nerves could bear any Thing of ſuch an acrid Nature; this Tenderneſs and Senſibility of theſe Organs muſt hinder us abſolutely from ſuppoſing that the Li-

quor of the Nerves can be acrid or pungent, or of the Nature of Spirit of Wine, Hartſhorn, *&c.*

50. Some have imagined the Liquor of the Nerves to be capable of vaſt Exploſion, like Gunpowder; or of violent ſudden Rarefaction like Air, or of ſtrong Ebullition like boiling Water, or the Mixture of Acids with alkaline Liquors. But as the Maſs of Blood from which this Fluid is derived, is not poſſeſſed of any ſuch Properties, we cannot ſuppoſe the Blood to furniſh what it has not in itſelf. Beſides, all theſe Operations are too violent for the Brain or Nerves to bear; and when once they are begun, are not ſo quickly controuled or reſtrained, as Experience teaches us the Nerves can be made to ceaſe from acting.

51. We are not ſufficiently acquainted with the Properties of an *Æther* pervading every Thing, to apply it juſtly in the animal Oeconomy, and it is as difficult to conceive, how it ſhould be retained in a long nervous Cord, as it is to have any Idea how it ſhould act. Theſe are Difficulties not to be ſurmounted.

52. The ſureſt Way of judging what Kind of Liquor this of the Nerves muſt be, is to examine the Liquors of ſimilar Parts of the Body. All the Glands ſeparate Liquors from the Blood much thinner than the compound Maſs itſelf; ſuch is the *Liquor* poured into the Cavity of the *Abdomen*, *Thorax*, *Ventricles of the Brain*, the *Saliva*, *pancreatic Juice*, *Lymph*, &c. Wherever there is Occaſion for ſecreted Liquors being thick and viſcid, in order to anſwer better the Uſes they are intended for, Nature has provided Reſervoirs for them to ſtagnate in, where their thinner Parts may be carried off

by the numerous abſorbent Veins diſperſed on the Sides of thoſe Cavities, or they may exhale where they are expoſed to the open Air. The *Mucus of the Noſe* becomes viſcid by Stagnation; for when it is immediately ſecreted, it is thin and watry, as appears from the Application of Sternutatories, *&c.* The *Cerumen* of the Ears is of a watry Conſiſtence, when juſt ſqueezed out. The *Mucus* of the alimentary Canal grows thick in the *Lacunæ*. The *Bile* in the hepatick Duct has little more Conſiſtence than Lymph; that in the Gall-bladder is viſcid and ſtrong. The *Urine* is much more watry as it flows from the Kidneys, than when it is excreted from the Bladder. The *Seed* is thin as it comes from the Teſticles, and is concocted in the *Veſiculæ ſeminales*, *&c.*

53. Hence (§ 52.) we may ſafely conclude, that a thin Liquor is ſecreted in the *Cortex Encephali* and *Medulla ſpinalis*; and ſeeing that the Thinneſs of ſecreted Liquors is generally as the Diviſions of the Veſſels into ſmall ſubtile Branches, and that the Ramifications within the Skull are almoſt infinitely ſubtile, the Liquor ſecreted in the *Encephalon* may be determined to be among the fineſt or thinneſt Fluids.

54. Seeing alſo that we can obſerve no large Reſervoir, where the Liquor ſecerned in the *cortical Subſtance* is depoſited, to have its finer Parts taken off, we have Reaſon to think, that it goes forward into the Nerves in the ſame Condition in which it is ſecerned.

55. By fine, or ſubtile animal Liquors, is meant no more than thoſe which are very fluid, and which ſeem to conſiſt of a large Proportion of watry Particles, and a leſſer one of

the oily, ſaline and terreſtrious Particles. Some of the Liquors which we can have in ſufficient Quantity to make Experiments with, are ſo fluid, and have ſo little Viſcidity or Coheſion of Parts, that when laid on a Piece of clean Mirrour, they will evaporate without leaving a Stain, ſuch is the Liquor ouzing out from the Surface of the *Pleura*, the Lymph, and ſeveral others.

If then theſe Liquors, which are ſubject to our Examination, the ſecerning Veſſels of which are ſo large that we can ſee them, have ſuch a ſmall Coheſion of Parts, it might not be unreaſonable to ſay, that the Liquor of the Nerves is as much more fine and fluid than Lymph, as the Veſſels ſeparating it are ſmaller; and therefore that the Fluid of the Nerves is a defecated Water, with a very ſmall Proportion of the other Principles extreamly ſubtilized.

56. Two Experiments are ſaid to contradict this Opinion of the Liquor of the Nerves being ſo fluid and ſubtile. One is, that upon cutting the *Canda equina* of a living Animal, a Liquor, as viſcid as the White of an Egg, drops out: The other is, that a wounded Nerve yields a *glairy Sanies*. But theſe don't appear to be the proper Fluid of the Nerves, ſince it is evident that what is diſcharged in both theſe Caſes, comes out of the cellular Subſtance involving the nervous Fibrils.

57. Conſidering how many Experiments make it evident, that there is a conſtant uninterrupted Stream of Liquors flowing through all the Canals of Animals, which convey Liquors, whoſe Particles are ſmaller than the Diame-

ter of their Canal, which is always the Caſe in a natural State, it is ſurprizing how it ever could be thought that the Liquid of the Nerves ſhould be obliged to flow from the Brain to each Muſcle the Moment we will; or that this Liquor ſhould flow back with the like Swiftneſs from the Extremity of each Nerve, to which an Object of Senſation was applied. The Nerves, as well as the other Excretories of the Glands are always full of Liquors, the Degree of Diſtenſion of the Canals not being always alike even in a ſound State: But this happens without Inconvenience, as the Sides of the Canals have a Power to accommodate themſelves to the preſent Quantity, unleſs it is very large or conſiderably diminiſhed, in both which Caſes Diſeaſes enſue.

58. The Motion of the Fluid in the Nerves will not only then be conſtant, but it will alſo be equal, or nearly ſo: For tho' the Blood in the larger Arteries is moved unequally by the unequal Forces, the Contraction of the Ventricle of the Heart, and the weaker Power, the Syſtole of the Arteries, yet the Difference between theſe two moving Powers comes to be leſs and leſs perceptible, as the Arteries divide into ſmaller Branches, becauſe of the numerous Reſiſtances which the Liquors meet with, and becauſe the Canals they move in become larger, till in the very ſmall arterious Branches there is no Difference in the Velocity of the Liquors from the Effect of the Heart or Arteries. The Motion of the Fluids muſt ſtill be more equal in the Excretories of Glands, and particularly in thoſe where the Veſſels have divided into very minute Branches. So that the

nervous Fluid will move conſtantly, equally and ſlowly, unleſs when its Courſe is altered by the Influence of the Mind, or by the Preſſure of ſome neighbouring active Organ.

59. We have perhaps no Idea of the Manner in which Mind and Body act upon each other; but if we allow that the one is affected by the other, and that the Fluid of the Nerves (whatever Name People pleaſe to give it) is a principal Inſtrument which the Mind makes uſe of to influence the Actions of the Body, or to inform itſelf of the Impreſſions made on the Body, we muſt allow that the Mind can direct this Inſtrument differently, particularly as to Quantity and Celerity.

60. Let us now ſuppoſe the nervous Fluid ſuch as has been argued for, to wit, an extreme fluid ſaponaceous Water, moving in a conſtant, equal, ſlow Stream, from the *Encephalon* and *Medulla ſpinalis* in each of the proper nervous Fibres, except when the Motion is changed by ſome acceſſory Cauſe, ſuch as the Mind, Preſſure of other Parts, *&c.* and let us examine how well ſuch a Suppoſition will agree with the Phænomena of the three great Functions, Nutrition, Senſation and muſcular Motion, which the Nerves are principal Inſtruments of.

In general we may ſay, that Nerves can carry Fluids to the moſt minute Part of the Body, to ſupply what is waſted in any of the Solids; that the Impreſſion made by the Objects of the Senſes on the very ſoft pulpy Extremities of the Nerves of the Organs of the Senſes, muſt make ſuch a Stop in the equal-flowing nervous Fluid, as muſt inſtantaneouſly be perceptible at the Fountain-head from which the Pipes affected ariſe, that the conſtant Flow of the Liquor of the Nerves into the Cavities of the *muſcular Fibrillæ*, occaſions the natural Contraction of Muſcles, by the conſtant *niſus* it makes to increaſe the tranſverſe, and to ſhorten the longitudinal Diameter of each Fibre, and that it is only to allow the Mind a Power of determining a greater Quantity of this ſame Fluid with a greater Velocity, into what muſcular Fibres it pleaſes, to account for the voluntary ſtrong Action of Muſcles.

61. But ſince ſuch a ſuperficial Account would not be ſatisfactory, it will be expected, that the principal Phænomena of theſe three Functions, ſhould be explained by the Means of ſuch a Fluid as has been ſuppoſed, and that the ſeveral Objections againſt this Doctrine ſhould be anſwered: Let us attempt this, and where we cannot extricate ourſelves from Difficulties which may be thrown in, let us boldly acknowledge Ignorance.

62. *α*. If Water, with a very ſmall Proportion of Oils and Salts from the Earth, proves a fit Nouriſhment for Vegetables, ſuch a Liquor as the Fluid of the Nerves has been deſcribed (§ 55.) may not be unfit for repairing the Waſte in Animals.

*β* The ſlow continual Motion of this nervous Fluid (§ 57, 58.) to the moſt minute Parts of the Body (§ 9.) is well enough calculated to ſupply the Particles that are conſtantly wore off from the Solids by the Circulation of the Liquors and neceſſary Actions of Life.

*γ*. The greater proportional Size of the *Encephalon*, in young Creatures, than in Adults ſeems calculated for their greater proportional Growth: For the younger the Animal is, the ſpeedier Growth and larger *Encephalon* it has.

δ. A Palſy and Atrophy of the Members generally accompanying each other, ſhew, that Nouriſhment, Senſation and Motion depend on the ſame Cauſe.

ε. It was ſaid (§ 25.) that the Nerves were *principal* Inſtruments in Nutrition, it was not affirmed, that they were the *ſole* Inſtruments; and therefore an *Atrophy* may proceed from the Compreſſion or other Leſion of an Artery, without being an Objection to the Doctrine here laid down.

63. *α.* All Objects of Senſe, when applied to their proper Organs, act by Impulſe; and this Action is capable of being increaſed by increaſing the impelling Force. In tangible Objects this is clearly evident, the cloſer they are preſſed to a certain Degree, the more diſtinct Perception enſues. Odorous Particles need the Aſſiſtance of Air moved rapidly to affect our Noſe: Sapid Subſtances that are ſcarce ſufficient to give us any Idea of their Taſte by their own Weight, are aſſiſted by the Preſſure of the Tongue upon the Palate: The Rays of Light collected drive light Bodies before them: Sound communicates a Vibration to all Bodies in harmonic Proportion with it. The Impulſe made thus by any of theſe Objects on the ſoft pulpy Nerves (§ 20.) which are full of Liquor, will preſs their Sides or Extremities, and their Liquor will be hindred from flowing ſo freely as it did. The Canals being all full, (§ 57.) this Reſiſtance muſt inſtantaneouſly affect the whole Column of Fluids in the Canals

that are preſſed and their Origins, and have the ſame Effect, as if the Impulſe had been made upon the Origin itſelf. To illuſtrate this by a groſs Compariſon, let any one puſh Water out of a Syringe through a long flexible Pipe, fixed to the Syringe, and he will be ſenſible of Reſiſtance, or a Puſh backwards the Moment any one ſtops the Orifice of the Pipe, or cloſes the Sides of it with his Fingers. This Impulſe made on the Nerves, and thus communicated to their Origin, will vary according to the Strength or Weakneſs, the Quickneſs or Slowneſs, the Continuance or ſpeedy Removal, the Uniformity or Irregularity, the Conſtancy or Alternation, &c. with which Objects are applied to the Nerves.

*b.* Whenever any Object is regularly applied with due Force to a Nerve rightly diſpoſed to be impreſſed by it, and is communicated, as juſt now explained, to the *Senſorium*, it gives a true and juſt Idea of the Object to the Mind.

*c.* The various Kinds of Impulſes, which the different Claſſes of Objects make, occaſion a Neceſſity of having the different Organs of the Senſes variouſly modified, ſo that the ſeveral Impulſes may be regularly applied to the Nerves in each Organ, or in other Words, we muſt have different Organs of the Senſes fitted to the different Claſſes of Objects.

*d.* As the Objects have one common Property of Impulſe, ſo all the Organs have moſt of the Properties of the Organ of Touching in common with the *Papillæ* of the Skin. In the Noſe and Tongue this is evident; in ſome Operations on the Eyes we can alſo perceive this, as we may likewiſe do in ſome Caſes, where Matter is collected in the internal Ear, *e.* Theſe Properties common to the Objects and the Organs, occaſion frequently uncommon Effects in the Application of an Object to an Organ proper to another Object of Senſation; for ſometimes we have the ſame Idea, as if the Object had been applied to its own proper Organ: At other times the Object is as it were changed, and we have the Idea as if the Organ had had its own proper Object applied to it. Thus, for Example, Light is the proper Object to be applied to the Eye, to give us any Idea of Colours; yet when all Light is excluded from the Eyes, an Idea of Light and Colours may be excited in us by Coughing, Sneezing, Rubbing, or ſtriking the Eye-ball. ——A Cane vibrating, but not ſo much as to give any Sound perceptible to the Ear, if it is applied to the Teeth, it raiſes a ſtrong Idea of Sound, as will alſo a little Inſect creeping in the *Meatus auditorius.*——The Fingers applied to two rough Surfaces, rubbing on each other, are ſenſible of the Sound they make; Surgeons of any Practice in the Cure of fractured Bones can bear Witneſs to the Truth of this.——The Fingers dipped in acid and ſeveral other acrid Liquors, have a Senſation very like to Taſting. ——Smelling and Taſting every Body knows are ſubſervient and aſſiſting to each other. From ſuch Examples we have further Proof of one general Cauſe of our Senſations, to wit, Impulſe from the Objects; and of ſuch a Similarity and Relation in the Organs, as might give Reaſon for imagining that any one of them would be capable of producing the Effect of another, if the Impulſes of the different Objects

jects could be regularly applied to each.

*f.* If the Impulſe of an Object is applied with due Force, but irregularly, a confuſed Idea of the Object is raiſed. Diſtant Objects are confuſed to *Myopes*, as very near ones are to *Preſbytæ*.

*g.* If the Application of the Impulſe is regular, but the Force with which it is applied is too weak, our Perception of the Object is too faint. One may whiſper ſo low as not to be heard.

*h.* If the Application of Objects is too violent, and there is any Danger of the tender Organs of our Senſes being hurt or deſtroyed, the uneaſy Senſation, we call *Pain*, is raiſed, whatever the Organ thus injured is. The Objects of Feeling affect every Organ: Thus Preſſure, cutting, pricking, Salts, pungent Oils, great Heat, violent Cold, *&c.* occaſion Pain, wherever they are applied. Beſides this, every particular Organ can be affected with Pain, by the too violent Application of it's own proper Object. Too much Light pains the Eyes; very loud Sound ſtuns the Ears; very odorous Bodies and too ſapid Objects hurt the Noſe and Tongue. A pretty ſure Proof this, that the Objects of our Senſes all act, and that the Organs are all impreſſed in nearly the ſame Way.

*i.* Whenever this uneaſy Senſation, *Pain*, is thus raiſed, a Sort of Neceſſity is as it were impoſed upon the Mind, to endeavour to get free of the injuring Cauſe, by either withdrawing the grieved Part of the Body from it, as one retires his Hand when his Finger is pricked or burnt; or the injuring Cauſe is endeavoured to be forced from the Body, as a *Teneſinus* puſhes acrid *Fæces* out of the *rectum.* In both theſe Operations a convulſive Contraction is immediately made in the leſed Part, or in the Neighbourhood of it; and if the Irritation is very ſtrong or permanent, the greater Part of the nervous Syſtem comes to be affected in that ſpaſmodic or convulſive Way.

This *Niſus* of the Mind to free the Body of what is in Danger of being very hurtful, may ſerve to explain the Phænomena of a great many Diſeaſes, when we are acquainted with the Diſtribution of the particular Nerves; and from this we can underſtand the Operation of Medicines that ſtimulate, and may learn how by exciting a ſharp but momentary Pain, we may free the Body of another Pain that would be more durable; and that by having it thus in our Power to determine a flow of the Liquor of the Nerves to any particular Part, for the Benefit of that Part or the Relief of any other diſeaſed Part, we can do conſiderable Service by a right Application of the proper Medicines.

*k.* If a Pain-giving Cauſe is very violent or long continued, it deſtroys the Organs either irrecoverably, or puts them ſo much out of Order, that they only gradually recover. People have been made blind or deaf for all their Lives after, by the violent Effect of Light on their Eyes or of Sound on their Ears, and we are frequently expoſed to as much Light and Sound as makes us unfit to ſee or hear for a conſiderable time after. I would explain this by a Ligature put round the tender Branch of an Herb; this Ligature drawn to a certain Degree may weaken the Canals ſo as to be unfit for the Circulation of the Juices a good While, till they are gradually explicated and made firm by theſe Juices. A ſtricter Ligature would diſorder the Structure of the Fibres ſo much, that the Liquors could not recover them. The Analogy is ſo plain that it needs no Commentary.

64. 1. In applying the Fluid of the Nerves to the Action of Muſcles, it was ſaid that the natural or involuntary Contraction of Muſcles was the *Niſus* which the nervous Fluid flowing conſtantly into the muſcular Fibres makes to diſtend theſe Fibrils, by enlarging their tranſverſe Diameters and ſhortning their Axes, and that voluntary Contraction was owing to a greater Quantity of that nervous Liquor determined towards the Muſcle to be put in Action, and poured with a greater *momentum* into the muſcular Fibrils by the Power of the Mind willing to make ſuch a Muſcle to act.

2. It has been objected to this Account of muſcular Motion, that if it was true, the Volume of a Muſcle in Contraction neceſſarily would be conſiderably increaſed by ſo much Liquor poured into its Fibrils, whereas it does not appear by any Experiment, that the Volume of a Muſcle is increaſed by its being put into Action.

3. To this it has been anſwered, That the Spaces between the muſcular Fibres are ſufficient to allow the Fibrils ſwelling during the Contraction of a Muſcle to lodge in, without any Addition to the Bulk of the Muſcle; and that it planly appears that theſe Spaces between the Fibrils are thus occupied, by the Compreſſion which the larger Veſſels of Muſcles, which run in thoſes Spaces, ſuffer during the Action

of a Muſcle; it is ſo great that the Muſcle becomes pale by contracting.

4. Another Objection to the Action of Muſcles being owing to the Influx of a Fluid into their Fibrils is, that muſcular Fibres are diſtractile, or capable of being ſtretched; and therefore when a Fluid is poured into their hollow Fibrils, they would be ſtretched longitudinally, as well as have their tranſverſe Diameters increaſed, that is, a Muſcle would become longer as well as thicker when it is put in Action, whereas it is known to every Body that a Muſcle is ſhortned while it acts.

5. In Anſwer to this it has been remarked, that though muſcular Fibrils are diſtractile, yet they will not yield to, or be ſtretched by every Force, however ſmall, that might be applied to them. A Cord that can be ſtretched in Length by the Weight of a Pound or two, would not yield in the leaſt to an Ounce or two; and it muſt likewiſe be obſerved, that gradually as any Body is ſtretched, its Reſiſtance to the ſtretching Force increaſes. A Rope may be ſtretched to a certain Length by a Pound Weight appended to it, which would require two Pounds to ſtretch it very little further; and therefore the general Obſervation of Animal Fibres being diſtractile, cannot be a reaſonable Objection to the Account of muſcular Motion above-mentioned, unleſs a Proof is brought that the Force which the Liquid of the Nerves muſt exert upon each Fibre of a Muſcle in order to make a Muſcle act, is capable of diſtracting or ſtretching the Fibres, which has not yet been attempted to be proved.

6. If muſcular Motion depends on the Influx

flux of the nervous Liquid, the inſtantaneous Contraction of a Muſcle, when the Mind wills to make it act, will eaſily be underſtood from the Nerves being always full of their Liquor, (§ 57.)

7. If either the Nerves of any Muſcle do not furniſh a ſufficient Quantity of their Liquor, or if the Fibres of a Muſcle become too eaſily diſtractile, ſuch a Muſcle will be unactive or paralytick.

8. If too great a Quantity of the Liquor of the Nerves is determined to a Muſcle or Muſcles, by any Cauſe which the Mind cannot command, ſuch Muſcle or Muſcles will be convulſed.

9. If the Motion of the Liquid of the Nerves is not uniform, but by Diſeaſe becomes irregular, an alternate Relaxation and Contraction of Muſcles may be the Conſequence, hence trembling Palſies, *chorea ſancti Viti*, &c.

10. Though the Nerves may not furniſh as much Liquor as may be ſufficient to make Muſcles contract with Strength enough to overcome the Reſiſtances to their Action, yet there may be enough of Liquor in the Nerves to allow the Impreſſions of Objects to be conveyed to the *ſenſorium*; this may be one Cauſe of a Member's being ſometimes ſenſible after it cannot be moved.

11. Unleſs the Liquor of the Nerves acquires ſome Energy in the Brain, which we have no Reaſon to think the Circulation of the Fluids in the Veſſels can give it, or unleſs it has other Properties than what we can diſcover in it, or unleſs there is an Agent determining its *momentum* towards ſome particular Parts,

which we are not conſcious of; if ſome of theſe don't obtain the Action of the Heart continuing of equal Force to propel our Liquors, notwithſtanding all the Reſiſtances that are to it, is not to be explained.

12. All Muſcles, but eſpecially the Heart, continue to contract in an irregular Way, after they are cut away from the Animal to whom they belonged, which may be owing to the Liquors continuing to flow in the ſmall Veſſels, and being poured irregularly into the muſcular *Fibrillæ*.

13. After the Heart or any other Muſcle cut away from an Animal has ceaſed to contract, its Contraction may again be reſtored by breathing upon it, or pricking it with any ſharp Inſtrument. That Heat or Pricking ſhould by their *ſtimulus* (§ 63. 1.) occaſion Contraction in a living Creature may be underſtood; but how they ſhould have the ſame Effect in a Muſcle ſeparated from an Animal, I know not.

*N. B.* Num. 11, 12, 13. are as inexplicable upon any other Suppoſition yet made concerning muſcular Motion.

65. I know no Experiment or Obſervations by which any thing can be proved, or from which any thing can be reaſonably inferred concerning the Uſes of the *Ganglions* of the Nerves, and therefore pretend to give no Account of them.

## Of the particular Nerves.

'TIS generally ſaid, that there are forty Pair of Nerves in all, of which ten come out from the *Encephalon*, and the other thirty have their Origin from the *Medulla ſpinalis*.

Of the ten Pair of Nerves which come from the *Encephalon*, the first is the *OLFACTORY*, which long had the Name of the *Mammillary Proceſſes* of the Brain, becauſe in the Brutes, Cows and Sheep, which were moſt commonly diſſected by the Ancients, the anterior Ventricles of the Brain are extended forwards upon theſe Nerves, and adhere ſo firmly to them, that the Nerves ſeem to make the lower Side of the Ventricles. Each of them is large, where it begins to be ſtretched out, and gradually becoming ſmaller, as it approaches the cribriform Bone, was imagined to reſemble a Nipple. Thoſe who miſtook the Ventricles for Part of the Nerves, obſerving the Cavity in them full of Liquor, concluded that theſe olfactory Nerves ſerved to convey the ſuperfluous Moiſture of the Brain to the Holes of the Ethmoid Bone through which it paſſed into the Noſe. But in Man, the Ventricles of whoſe Brain are not thus extended forwards, theſe Nerves are ſmall, long, and without any Cavity, having their Origin from the *corpora ſtriata*, near the Part where the internal carotid Arteries are about to ſend off their Branches to the different Parts of the Brain, and in their

Courſe under the anterior Lobes of the Brain, which have a Depreſſion made for lodging them, the human olfactory Nerves become larger till they come to the cribriform Bone, where they ſplit into a great Number of ſmall Filaments to paſs through the little Holes in that Bone, and then each being joined by a Branch of the fifth Pair of Nerves, is ſpread on the Membrane of the Noſe.

The tender Structure and ſudden Expanſion of theſe Nerves on ſuch a large Surface, render it impoſſible to trace them far; which has made ſome Authors deny them to be Nerves: But when we break the Circumference of the *cribriform Lamella*, and then gently raiſe it, we may ſee the Diſtribution of the Nerves ſome way on the Membrane of the Noſe.

The Contrivance of defending theſe long ſoft Nerves from being too much preſſed by the anterior Lobes of the Brain under which they lye, is ſingular, becauſe they have not only the prominent orbitar Proceſſes of the frontal Bone to ſupport the Brain on each Side, with the Veins going into the longitudinal Sinus, and other Attachments bearing it up, but there is a Groove formed in each Lobe of the Brain itſelf for them to lodge in.— Their ſplitting into ſo many ſmall Branches before they enter the Bones of the Skull, is likewiſe peculiar to them; for generally the Nerves come from the Brain in diſgregated Filaments, and unite into Cords, as they are going out at the Holes of the Bones. This Contrivance is the beſt for anſwering the Purpoſe they are deſigned for, of being the Organ of Smelling; for had they been expanded upon the Membrane of the Noſe into a medullary Web, ſuch as the optic Nerve forms, it would have been too ſenſible to bear the Impreſſions of ſuch Objects as are applied to the Noſe, and a Diſtribution in the more common way of a Cord ſending off Branches, would not have been equal enough for ſuch an Organ of Senſation.

The 2*d* Pair of Nerves is the ***OPTIC***, which riſe from the *thalami nervorum opticorum*, and then, after making a large Curve outwards, run obliquely inwards and forwards till they unite at the Fore-part of the *Sella Turcica*, and then dividing again, each runs obliquely forwards and outwards to go out at its proper Hole in the ſphenoid Bone, accompanied with the ocular Artery, to run afterwards to the Globe of the Eye, within which each is extended into a very fine Cup-like Web that lines all the In-ſide of the Eye as far forwards as the *ciliary Circle*, and is univerſally known by the Name of *Retina*.

Tho' the Subſtance of this Pair of Nerves ſeems to be blended at the Place where they are joined, yet Obſervations of People whoſe optic Nerves were not joined at all, and of others who were blind of one Eye from a Fault in the optic Nerve, or in thoſe who had one of their Eyes taken out, make it appear that there is no ſuch intimate Union of Subſtance; the optic Nerve of the affected Side only being waſted, while the other was large and plump; and the ſame Obſervations are contradictory to the Doctrine of a Decuſſation of all the Nerves (§ 7.); for the Diſeaſe could be traced from the affected Eye to the

Origin of the Nerve on the ſame Side. In many Fiſhes indeed, the Doctrine of Decuſſation is favoured, for their optic Nerves plainly croſs each other without any Union at the Part where they are joined in Men and moſt Quadrupeds.

Thoſe People whoſe optic Nerves were not joined, having neither ſeen Objects double, nor turned their Eyes different Ways, is alſo a plain Proof that the Conjunction of the optic Nerves will not ſerve to account for either the uniform Motions of our Eyes, or our ſeeing Objects ſingle with two Eyes.

The *Retina* of a recent Eye, without any Preparation, appears a very fine Web, with ſome Blood-Veſſels coming from its Center to be diſtributed on it; but after a good Injection of the Arteries that run in the Subſtance of this Nerve as is common to other Nerves, it is with Difficulty that we can obſerve its nervous medullary Subſtance.—— The Situation of theſe Veſſels in the central Part of the optic Nerve, and the want of medullary Fibres here, where the optick Nerve enters the Ball of the Eye, may be one Reaſon why we do not ſee ſuch Bodies or Parts of Bodies, whoſe Picture falls on this central Part of the *Retina*.— An Inflammation in thoſe Arteries of the *Retina*, which an *Opthalmia* is generally attended with, may very well account for that Tenderneſs in the Eyes, and Inability to bear the Light, which People have in that Diſeaſe.—— The Over-diſtenſion of theſe Veſſels may likewiſe ſerve to account for the black Spots obſerved on bright-coloured Bodies eſpecially, and for that ſmoaky Fog, thro' which all Objects are ſeen by People in ſome Fevers.—— If thoſe Veſſels loſe their Tone, and remain preternaturally diſtended, no Objects affect our *Retina*, though the Eye externally appears ſound, or this may be one Cauſe of an *Amauroſis* or *Gutta ſerena.*

The *THIRD PAIR* riſe from the anterior Part of the *Proceſſus annularis*, and piercing the *Dura Mater* a little before and to a Side of the lateral Extremities of the poſterior clinoid Proceſs of the ſphenoid Bone, run along the *Receptacula*, or *cavernous Sinuſes*, at the Side of the *Ephippium*, to get out at the *Foramina lacera*, to be diſtributed to the Globe of the Eye, to the *Muſculus rectus* of the *Palpebra*, and to the *Attollens*, *Adductor*, *Deprimens* and *obliquus minor* Muſcles of the Eye-ball. Theſe Muſcles being principal Inſtruments in the Motions of the Eye-lid and Eye-ball, this Nerve has therefore got the Name of the *Motor Oculi.*—— I have frequently obſerved in Convulſions the Eye-lids widely opened, the *Cornea* turned upwards and outwards, and the Eye-balls ſunk in the Orbit; which well deſcribed the conjunct Action of the Muſcles which this Pair of Nerves ſerves.— The Diſtenſion of a conſiderable Branch of the Carotid, which paſſes over this Nerve near its Origin on each Side, may poſſibly be the Reaſon of that Heavineſs in the Eye-lids and Eyes, after drinking hard or eating much.

The *FOURTH PAIR*, which are the ſmalleſt Nerves of any, derive their Origin from the poſterior Baſe of the *Teſtes*, and then making a long Courſe on the Side of the annular Protuberance, enter the *Dura Mater* a little farther back and more externally than the third

Pair, to run alſo along the *Receptacula*, to paſs out at the *Foramina lacera*, and to be entirely ſpent on the *Muſculi trochleares*, or ſuperior oblique Muſcles of the Eyes. The rotatory Motions, and the Advancement of the Eye-balls forward, by which Motions ſeveral of our Paſſions are expreſſed, principally depending on theſe Muſcles, the Nerves that ſerve them have got the Name of *PATHETICI*.

The *FIFTH PAIR* are large Nerves, riſing from the annular Proceſs, where the medullary Proceſſes of the *Cerebellum* join in the Formation of that *Tuber*, to enter the *Dura Mater* near the Point of the petrous Proceſs of the Temporal Bones, and then ſinking into the *Receptacula* at the Side of the *Sella Turcica*, each becomes in Appearance thicker, and goes out of the Skull in three great Branches.

The firſt Branch of the fifth is the *OPHTHALMICK*, which runs through the *Foramen lacerum* to the Orbit, having in its Paſſage thither a Connexion with the 6th Pair: It is afterwards diſtributed to the Ball of the Eye with the 3d; to the Noſe, along with the Olfactory, which the Branch of the fifth that paſſes through the *Foramen orbitarium internum*, joins, as was already mentioned in the Deſcription of the firſt Pair. This ophthalmic Branch likewiſe ſupplies the *Glandula lacrymalis*, Fat, Membranes, Muſcles and the Teguments of the Eye-lids, its longeſt fartheſt extended Branch paſſing through the *Foramen ſuperciliare* of the *Os frontis* to be diſtributed to the Forehead.

The ſmall Fibres which this firſt Branch of the fifth and the third Pair of Nerves ſend to the

Eye-ball, being ſituated on the optic Nerve, and after piercing the ſclerotick Coat running on the choroid Coat on the Outſide of the *Retina* in their Courſe to the *Uvea or Iris*, may be a Cauſe of the Sympathy between the optic Nerve and the *Uvea*, by which we more readily acquire the Habit of contracting the *Iris*, and thereby leſſen the Pupil, when too ſtrong Light is excluded, and on the contrary enlarge the Pupil, when the Light is too faint.——This, with the Sympathy which muſt ariſe from ſome of the Nerves of the Membrane of the Noſtrils being derived from this firſt Branch of the fifth Pair of Nerves, may alſo be the Cauſe, why an Irritation of too ſtrong a Light falling upon the *Retina* may produce Sneezing, as if a *Stimulus* had been applied to the Membrane of the Noſe itſelf.——In the Megrim all the Branches of this Nerve diſcover themſelves to be affected; for the Fore-head is racked with Pain, the Eye-ball is pain'd, and feels as if it was ſqueezed, the Eye-lids ſhut convulſively, the Tears trickle down, and an uneaſy Heat is felt in the Noſe. Hence we can underſtand, where external Medicines will have the beſt Effect, when applied to remove this Diſeaſe, to wit, to the Membrane of the Noſe and to the Forehead; and, why alternate Preſſure near the ſuperciliary Hole of the frontal Bone ſometimes gives immediate Relief in the Megrim.

The ſecond Branch of the fifth Pair of Nerves may be called *MAXILLARIS SUPERIOR*, from its ſerving principally the Parts of the upper Jaw. It goes out at the round Hole of the ſphenoid Bone, and ſends immediately one Branch in the Channel on the

Top of the *Antrum maxillare*, the Membrane of which and the upper Teeth are ſupplied by it in its Paſſage. As this Branch is about to go out at the *Foramen Orbitarium externum*, it ſends a Nerve through the Subſtance of the *Os maxillare* to come out at *Steno*'s Duct, to be diſtributed to the Fore Part of the Palate; and what remains of it eſcaping at the *external Orbitar* Hole, divides into a great many Branches, that ſupply the Cheek, upper Lip and Noſtril. The next conſiderable Branch of the *ſuperior maxillary* Nerve is ſent into the Noſe by the Hole common to the Palate and ſphenoidal Bone, and the remaining Part of this Nerve runs in the *Palato-maxillaris* Canal, giving off Branches to the Temples and Pterygoid Muſcles, and comes at laſt into the Palate to be loſt.——Hence the Ach in the Teeth of the upper Jaw occaſions a gnawing Pain deep-ſeated in the Bones of the Face, with a ſwelling in the Eye-lids, Cheek, Noſe and upper Lip; and on the other Hand, an Inflammation in theſe Parts is often attended with ſharp Pain, in the Teeth.——Hence an Obſtruction in the Duct of the maxillary Sinus, which obliges the Liquor ſecreted there to find out a preternatural Route for itſelf, as I have ſeen more than once, may be occaſioned by the Pain of the Teeth.

The third or *MAXILLARIS INFERIOR* Branch of the fifth Pair going out at the oval Hole of the ſphenoid Bone, ſerves the Muſcles of the lower Jaw, and the Muſcles ſituated between the *Os hyoides* and *Jaw*; all the ſalivary Glands, the *Amygdalæ* and the external Ear have Branches from it; it has a large

Branch loſt in the Tongue, and ſends another through the Canal in the Subſtance of the lower Jaw, to ſerve all the Teeth there, and to come out at the Hole in the anterior Part of the Jaw, to be loſt in the Chin and Under-lip. ——Hence a convulſive Contraction of the Muſcles of the lower Jaw, or the Mouth's being involuntarly ſhut, a great Flow of Spittle or Salivation, a Pain in the Ear eſpecially in Deglutition, and a Swelling all about the Throat, are natural Conſequences of a violent Irritation of the Nerves of the lower Teeth in the Tooth-ach; and Pain in the Teeth and Ear is as natural a Conſequence of an *Angina.*—Hence alternate Preſſure on the Chin may ſometimes relieve the Violence of a Tooth-ach.—Hence deſtroying the Nerves of a Tooth by actual or potential Cauteries, or pulling a carious Tooth, ſo often removes immediately all theſe Symptoms.———Hence no Cure is to be found for ſome Ulcers in the upper or lower Jaw, but by drawing a Tooth.——Perhaps the Sympathy of the Organs of Taſting and Smelling may in ſome Meaſure depend on their both receiving Nerves from the fifth Pair.

The *SIXTH PAIR*, which is the ſmalleſt except the fourth, riſes from the Forepart of the *Corpora pyramidalia*, and each entering the *Dura Mater* ſome way behind the Extremity of the poſterior clinoid Proceſſes of the ſphenoid Bone, has a long Courſe below that Membrane, and within the *Receptaculum* at the Side of the *Sella Turcica*, to go out at the *Foramen lacerum* into the Orbit, to ſerve the Abductor muſcle of the Eye. In this Paſſage this Nerve lies very contiguous to the internal carotid Artery, and to the ophthalmick Branch of the fifth Pair of Nerves. At the Place where this ſixth Pair is contiguous to the Carotid, a Nerve, either goes from each of them in an uncommon Way, to wit, with the Angle beyond where it riſes obtuſe, to deſcend with the Artery, and to form the Beginning of the Intercoſtal, according to the common Deſcription; or, according to other Authors, this Nerve comes up from the great *Ganglion* of the *Intercoſtal* to be joined to the ſixth here.

The Arguments for this latter Opinion are, That according to the common Opinion, this Beginning of the *intercoſtal* Nerve, as 'tis called, would riſe in a Manner not ſo ordinary in Nerves. In the next Place it is obſerved, that the ſixth Pair is larger nearer to the Orbit, than it is before it comes to the Place where this Nerve is ſaid to go off; and therefore it is more probable, that it receives an Addition there rather than gives off a Branch. *Laſtly*, It is found, that upon cutting the *intercoſtal* Nerves of living Animals, the Eyes plainly were affected, they loſt their bright Water, the Gum, or Gore as we call it, was ſeparated in greater Quantity, the Pupil was more contracted, the cartilaginous Membrane at the internal Canthus came more over the Eye, and the Eye-ball itſelf was diminiſhed.

To this it is anſwered in Defence of the more common Doctrine. 1*ſt*, That other Branches of Nerves go off in a reflected Way as well as this does, ſuppoſing it to be the Beginning of the Intercoſtal, and that the Reflection would rather be greater, if it is thought to come up from the Intercoſtal to the ſixth. 2*ly*, It is denied that this Nerve is for ordinary thicker at its anterior than its poſterior Part, and if it was ſuppoſed to be thickeſt neareſt to the Orbit, the Concluſion made above cou'd not be drawn from this Appearance, becauſe other Nerves enlarge ſometimes where there is no Addition made to them, as in the Inſtance already mentioned of the Trunk of the fifth Pair while below the *Dura Mater*. *3dly*, The Experiments on living Animals ſhew indeed, that the Eyes are affected upon cutting the intercoſtal Nerve, but not in the Way which might have been expected, if the *Intercoſtal* had furniſhed ſuch a Share of the Nerve that goes to the *Abductor* Muſcle of the Eye; for it might have been thought, that this Muſcle would have been ſo much weakned immediately upon cutting the *Intercoſtal*, as its Antagoniſt the *Adductor* would have greatly prevailed over it, and have turned the Eye ſtrongly in towards the Noſe, which is not ſaid to be a Conſequence of this Experiment. So that the Arguments are ſtill equivocal, and more Obſervations and Experiments muſt be made before it can be determined with Certainty, whether the ſixth Pair gives or receives a Branch here. In the mean time I ſhall continue to ſpeak about the Origin of the *Intercoſtal* with the Generality of Anatomiſts.

At this Place where the Intercoſtal begins, the fifth Pair is contiguous and adherent to the ſixth; and it is generally ſaid, that the ophthalmick Branch of the fifth gives a Branch or two to the Beginning of the Intercoſtal, or receives ſuch from it. Others deny any ſuch Communication between them, and thoſe who affirm the Communication confeſs, that in ſome Subjects they could not ſee it. After examining the Nerves here in a great many Subjects, I cannot determine whether or not there are nervous Filaments going from the one to the other. Sometimes I have thought that I traced them evidently; at other times I obſerved that what I diſſected for nervous Filaments, was collapſed cellular Subſtance; and in all the Subjects where I had puſhed an Injection ſucceſsfully into the very ſmall Arteries, I could only obſerve a *Plexus* of Veſſels connecting the one to the other. In any of theſe Ways however there is as much Connexion, as we are aſſured from many Experiments and Obſervations on other Nerves, is ſufficient to make a very great Sympathy among the Nerves here.——Poſſibly the Appearances in the Eyes of Dogs, whoſe intercoſtal Nerves were cut, might be owing to this Sympathy.

The *SEVENTH PAIR* comes out from the lateral Part of the *annular Proceſs*, behind where the medullary Proceſſes of the *Cerebellum* are joined to that *Tuber*, and each being accompanied with a larger Artery than moſt other Nerves, enters the *internal Meatus auditorius*, where the two large Bundles of Fibres, of which it appeared to conſiſt within the Skull, ſoon ſeparate from each other; one of them entring by ſeveral ſmall Holes into the *Veſtible*, *Cochlea* and *ſemicircular Canals*, is ſtretched on this inner *Camera* of the Ear in a very ſoft pulpy Subſtance; and being never ſeen in the Form of a firm Cord, ſuch as the other Parcel of this and moſt other Nerves become, is called *PORTIO MOLLIS* of the auditory Nerve.

The other Part of this ſeventh Pair paſſes through *Galen's Foramen cæcum* or *Fallopius's Aquæduct* in its crooked Paſſage by the Side of the *Tympanum*, in which Paſſage a Nerve ſent from the lingual Branch of the inferior maxillary Nerve, along the outſide of the *Tuba Euſtachiana*, and croſs the Cavity of the *Tympanum*, where it has the Name of *Chorda Tympani*, is commonly ſaid to be joined to it. The very acute Angle which this Nerve makes with the fifth, or the ſudden violent Reflexion it would ſuffer, on the Suppoſition of its coming from the fifth to the ſeventh appears unuſual, whereas if we ſuppoſe that it comes from the ſeventh to the fifth, its Courſe would be more in the ordinary Way, and the *Chorda tympani* would be eſteemed a Branch of the ſeventh Pair going to join the fifth. This ſmaller Bundle of the ſeventh gives Branches to the Muſcles of the *Malleus* and to the *Dura Mater*, while it paſſes through the bony crooked Canal, and at laſt comes out in a firm Cord named *PORTIO DURA*, at the Extremity of this Canal, between the *ſtyloid* and *maſtoid* Proceſſes of the temporal Bone, giving immediately Filaments to the little oblique Muſcles of the Head, and to thoſe that riſe from the ſtyloid Proceſs. It then pierces through the parotid Gland, and divides into a great many Branches, which are diſperſed in the Muſcles and Teguments that cover all the Side of the ſuperior Part of the Neck, the whole Face and *Cranium*, as far back as the Temples, including a conſiderable Part of the external Ear. Its Branches having thus a conſiderable Connexion with all the three Branches of the fifth Pair, and with the ſecond cervical, occaſions a conſiderable Symphathy of theſe Nerves with it. —Hence in the Tooth-ach, the Pain is ſometimes very little in the affected Tooth, compared to what it is all along the Side of the Head and in the Ear.—Hence probably the Relief of the Tooth-ach by Bliſters applied behind the Ear, or by a hot Iron touching the *Antihelix* of the Ear.—By this Communication or Connexion poſſibly too it is, that a vibrating String held between one's Teeth, gives a ſtrong Idea of Sound to the Perſon who holds it, which no Body elſe can perceive.—Perhaps too the Diſtribution of this Nerve occaſions the Head to be ſo quickly turned upon the Impreſſion of Sound on our Ears.

The ***EIGHTH PAIR*** of Nerves riſe from the lateral Baſes of the *Corpora olivaria* in diſgregated Fibres, and as they are entring the anterior internal Part of the Holes common to the *Os Occipitis* and *Temporum*, each is joined by a Nerve which aſcends within the *Dura Mater* from the tenth of the Head, the firſt and ſecond cervical, and ſometimes from inferior Nerves: This every Body knows has the Name of the ***NERVUS ACCESSORIUS***. When the two get out of the Skull, the *Acceſſorius* ſeparates from the eighth, and deſcending obliquely outwards, paſſes through the *Sternomaſtoideus* Muſcle, to which it gives Branches, and afterwards terminates in the *Trapezius* and *Rhomboid* Muſcles of the *Scapula*. In this Courſe it is generally more or leſs joined by the ſecond cervical Nerve.

The large *eighth Pair* ſoon after its Exit gives Nerves to the Tongue, *Larynx*, *Pharynx* and *Ganglion* of the *Intercoſtal* Nerve, and being disjoined from the 9th and Intercoſtal, to which it adheres cloſely ſome way, runs ſtreight down the Neck behind the internal jugular Vein, and at the exterior Side of the carotid Artery. As it is about to enter the *Thorax*, a large Nerve goes off from the eighth of each Side: This Branch of the right Side turns round from the anterior to the poſterior Part of the ſubclavian Artery, while the Branch of the left Side turns round the great Curve of the *Aorta*, and both of them mounting up again at the Side of the *OEſophagus*, to which they give Branches, are loſt at laſt in the *Larynx*. Theſe are called the *RECURRENT* Nerves, which we are deſired to ſhun in the Operation of *Bronchotomy*, tho' their deep Situation protects them ſufficiently.——The Muſcles of the *Larynx* being in a good Meaſure ſupplied with Nerves from the Recurrents, it is to be expected, that the cutting of them will greatly weaken the Voice, tho' it will not be entirely loſt, ſo long as the ſuperior Branches of the eighth Pair are entire.

The eighth Pair at or near the Place where the recurrent Nerves go off from it, or frequently the Recurrents themſelves ſend off Nerves to the *Pericardium*, and to join with the Branches of the Intercoſtal that are diſtributed to the Heart.

After theſe Branches are ſent off, the *Par vagum* on each Side deſcends behind the great Branch of the *Trachea* and gives numerous Filaments to the Lungs in going to the *OEſophagus*. The one of the left Side running on the Forepart of the *OEſophagus*, communicates by ſeveral Branches with the right one in its Deſcent to be diſtributed to the Stomach: The right one gets behind the *OEſophagus*, where it ſplits and rejoins ſeveral times before it arrives at the Stomach, to which it ſends Nerves; and then being joined by a Branch from the left Trunk, they run towards the cæliac Artery, there to join into the great *ſemilunar Ganglion* formed by the two Intercoſtals.

From the Diſtribution of this *Par vagum*, we may learn how tickling the *Fauces* with a Feather or any ſuch Subſtance, excites a Nauſea and Inclination to vomit.——Why coughing occaſions vomiting, or vomiting raiſes a Cough.———Hence we ſee how the nervous *Aſthma* and the *Tuſſis convulſiva*, Kinkcough, are attended with a ſtraitning of the *Glottis*, Why Food difficult of digeſting occaſions the *Aſthma* to weakly People, and why *Emetics* have frequently cured the *Aſthma* very ſpeedily. —Why an Attempt to vomit is ſometimes in danger of ſuffocating *Aſthmatic* People.——— Why the ſuperior Orifice of the Stomach is ſo ſenſible as to be looked on as the Seat of the Soul by ſome.——Why People ſubject to Diſtenſions of the Stomach have ſo often the Senſations of Balls in their Breaſt or Throats.—— Why the *Globus hyſtericus* is ſo often attended with a violent Strangulation at the *Glottis*.

The *NINTH PAIR* of Nerves comes from the inferior Part of the *Corpora pyramidalia*, to go out of the Skull at their proper Holes of the occipital Bones. After their Egreſs they adhere for ſome way firmly to the 8th and Intercoſtal, and then ſending a Branch that in many Subjects is joined with Branches of the firſt and ſecond cervical Nerves, to be diſtributed to the Thyroid Gland and Muſcles on the Fore-part of the *Trachea Arteria*, the 9th is loſt in the Muſcle and Subſtance of the Tongue. Some have thought this Nerve, and others have eſteemed the third Branch of the fifth Pair of Nerves to be the proper guſtatory Nerve. I know no Obſervations or Experiments to prove either Opinion, or to aſſure us that both Nerves do not ſerve for Taſting, and for the Motion of the Tongue.

The *TENTH PAIR* riſes from the Sides of the *Medulla ſpinalis*, to go out between the *Os Occipitis* and *firſt Vertebra* of the Neck. After each of them has given a Branch to the great Ganglion of the Intercoſtal Nerve, they are diſtributed to the oblique Muſcles, and to ſome of the Extenſors of the Head. Whether the Name of the tenth of the Head, or of the firſt Vertebral, ought to be given to this Pair of Nerves, is of no ſuch Conſequence as to deſerve a Debate.

In the Deſcription of the ſixth Pair, I followed the uſual way of ſpeaking among Anatomiſts, and called *that* the Beginning of the Intercoſtal Nerve which comes out of the Skull, and therefore ſhall here ſubjoin a curſory Deſcription of this Nerve, notwithſtanding its much larger Part is compoſed of Nerves coming out from the *Medulla ſpinalis*. There is no greater Incongruity in Point of Method to ſay, that the Nerve we are deſcribing receives Additions from others that have not been deſcribed, than it is to repeat in the Deſcription of a great many Nerves, that each of them gives Branches to form a Nerve which we are ignorant of, which is all the Difference between deſcribing the Intercoſtal before or after the ſpinal Nerves.

The Branch reflected from the ſixth Pair, joined poſſibly by ſome Filaments of the *Ophthalmic* Branch of the fifth, runs along with the internal Carotid thro' the crooked Canal formed for this Artery in the *temporal Bone*, where the little Nerve is very ſoft and pappy, and in ſeveral Subjects divides and unites again before it comes out of the Skull. As ſoon as the Nerve eſcapes out of this bony Canal it is connected a little way with the eighth and ninth, then ſeparating from theſe, after ſeeming to receive additional Nerves from them, it forms a *large Ganglion*, into which Branches from the tenth of the Head, and from the firſt and ſecond cervical enter. From this Ganglion the Nerves come out again ſmall to run down the Neck along with the carotid Artery, communicating by Branches with the cervical Nerves, and giving Nerves to the Muſcles that bend the Head and Neck. As the *Intercoſtal* is about to enter the *Thorax*, it forms another Ganglion from which Nerves are ſent to the *Trachea* and to the Heart; theſe deſigned for the Heart joining with the Branches of the eighth, and paſſing between the two great Arteries and the Auricles to the Subſtance of that Muſcle. The Intercoſtal after this conſiſting of two Branches, one going behind, and the other running over the anterior Part of the Subclavian Artery, forms a new Ganglion where the two Branches unite below that Artery, and then deſcending along the Sides of the *Vertebræ* of the *Thorax*, receives Branches from each of the dorſal Nerves, which Branches appearing to come out between the Ribs, have given the Name of Intercoſtal to the whole Nerve. Where the Addition is made to it from the fifth dorſal Nerve, a Branch goes off obliquely forwards, which being joined by other ſuch Branches from the ſixth, ſeventh, eighth and ninth dorſal, an anterior Trunk is formed that paſſes between the Fibres of the *Appendix muſculoſa* of the Diaphragm to form along with the other Intercoſtal and the Branches of the eighth Pair, a large ſemilunar Ganglion ſituated between the cæliac and ſuperior meſenteric Arteries; the Roots of which are, as it were, involved in a ſort of nervous Network of this Ganglion, from which a great Number of very ſmall nervous Threads run out to be extended on the Surface of all the Branches of theſe two Arteries, ſo as to be eaſily ſeen when any of the Arteries are ſtretched, but not to be raiſed from them by Diſſection; and thus the *Liver*, *Gall-Bladder*, *Duodenum*, *Pancreas*, *Spleen*, *Jejunum*, *Ilium*, and a large Share of the *Colon* have their Nerves ſent from this great *ſolar Ganglion* or *Plexus*.

Several Fibres of this Ganglion running down upon the Aorta, meet with other Nerves ſent from the poſterior Trunk of the Intercoſtal, which continues its Courſe along the Sides of the *Vertebræ*, they ſupply the *Glandulæ renales*, Kidneys and *Teſtes* in Men or *Ovaria* in Women; and then they form a Net-work upon the inferior meſenteric Artery where the Nerves of the two Sides meet, and accompany the Branches of this Artery to the Part of the *Colon* that lies in the left Side of the Belly, and to the *Rectum* as far down as the lower Part of the *Pelvis*.

The Intercoſtal continuing down by the Side of the *Vertebræ* of the Loins, is joined by Nerves coming from between theſe *Vertebræ*, and ſends Nerves to the Organs of Generation and others in the *Pelvis*, being even joined with thoſe that are ſent to the inferior Extremities.

The almoſt univerſal Connexion and Communication which this Nerve has with the other Nerves of the Body, may lead us to underſtand the following and a great many more *Phænomena*, Why the too great Quantity of Bile in the *Cholera* occaſions Vomiting as well as Purging. —Why People vomit in Colicks, in Inflammations or other Irritations of the Liver, or of the Ducts going from it and the Gall-Bladder.—— Why a Stone in the Kidneys, or Ureters, or any other Cauſe irritating thoſe Organs, ſhould ſo much more frequently bring on Vomiting and other Diſorders of the Stomach, than the Stone or any other ſtimulating Cauſe in the Bladder does.——Why Vomiting is a Symptom of Danger after Child-birth, Lithotomy and other Operations on the Parts in the *Pelvis*.—— Why the Obſtructions of the *Menſes* are capable of occaſioning Strangulations, Belching, Colicks, Stomach-aches, and even Convulſions in the Extremities.——Why Veſicatories applied from the Ears to the Clavicles of Children labouring under the *Tuſſis convulſiva* are frequently of great Service.——Why Worms in the Stomach or Guts excite an Itching in the Noſe or Grinding of the Teeth.——Why Irritations in the Bowels of the Belly occaſion ſometimes univerſal Convulſions of the Body.

The *ſpinal* Nerves riſe generally by a Number of diſgregated Fibres from both the anterior and poſterior Part of the *Medulla ſpinalis*, and ſoon after form à little Knot or Ganglion where they acquire ſtrong Coats, and are extended into firm Cords. They are diſtinguiſhed by Numbers, according to the *Vertebræ* from between which they come out, the ſuperior of the two Bones forming the Hole thro' which they paſs, being the one from which the Number is applied to each Nerve. There are generally ſaid to be *thirty Pair* of them, ſeven of which come out between the *Vertebræ* of the *Neck*, twelve between thoſe of the *Back*, five between thoſe of the *Loins*, and ſix from the *falſe Vertebræ*.

The *FIRST CERVICAL* Pair of Nerves comes out between the firſt and ſecond *Vertebræ* of the Neck, and having given Branches to join with the tenth Pair of the Head, the ſecond Cervical and Intercoſtal, and to ſerve the Muſcles that bend the Neck, it ſends its largeſt Branches backwards to the Extenſor Muſcles of the Head and Neck; ſome of which piercing through theſe Muſcles run up on the *Occiput* to be loſt in the Teguments there; and many Fibres of it advance ſo far forward, as to be connected with the *Fibrillæ* of the firſt Branch of the fifth Pair of the Head, and of the *Portio Dura* of the *Auditory Nerve*. —— Hence poſſibly it is that a *Clavus hyſtericus* changes ſuddenly ſometimes from the Fore-head to a violent Pain and Spaſm in the Back-part of the Head and Neck.

The *SECOND CERVICAL* is ſoon joined by ſome Branches to the ninth of the Head and Intercoſtal, and to the firſt and third of the Neck, then has a large Branch that comes out at the exterior Edge of the *Sternomaſtoideus* Muſcle, where it joins with the *Acceſſorius* of the eighth Pair, and is afterwards diſtributed to the *Platyſma Myoides*, Teguments of the Side of the Neck and Head, parotid Gland and external Ear, being connected to the *Portio Dura* of the Auditory Nerve and to the firſt cervical. The Remainder of this ſecond Cervical is ſpent on the *Levator Scapulæ*, and the Extenſors of the Neck and Head. Generally a large Branch is here ſent off to join the *Acceſſorius* of the eighth Pair, near the ſuperior Angle of the *Scapula*.

To the Irritation of the Branches of this Nerve, it probably is, that in an Inflammation of the parotid Gland, the Neck is pain'd as far down as the Clavicle, the Head is drawn towards the Shoulder of the affected Side, and the Chin is turned to the other Side.—— In opening the external jugular Vein, no Operator can promiſe not to touch ſome of the cutaneous Branches of this Nerve with the Lancet, which occaſions a ſharp pricking Pain in the mean Time, and a Numneſs of the Skin near the Orifice for ſome Time after.

The *THIRD PAIR* of the Neck paſſes out between the third and fourth cervical *Vertebræ*, having immediately a Communication with the ſecond, and ſending down a Branch, which being joined by a Branch from the fourth cervical forms the *PHRENIC* Nerve. This deſcending enters the *Thorax* between the ſubclavian Vein and Artery, and then being received into a Groove formed for it in the

*Pericardium*, it has its Courſe along this *Capſula* of the Heart, till it is loſt in the middle Part of the Diaphragm. The right Phrenic has a ſtreight Courſe, but the left one is obliged to make a conſiderable Turn outwards to go over the prominent Part of the *Pericardium*, where the Point of the Heart is lodged. Hence in violent Palpitations of the Heart, a pungent acute Pain is felt near the left Orifice of the Stomach.

The other Branches of the third cervical Nerve are diſtributed to the Muſcles and Teguments at the inferior Part of the Neck and Top of the Shoulder. No Wonder then that an Inflammation of the Liver or Spleen, an Abſceſs in the Lungs adhering to the Diaphragm, or any other Cauſe capable of irritating the Diaphragm, ſhould be attended with a ſharp Pain in the Top of the Shoulder, as well as Wounds, Ulcers, *&c.* of this Muſcle itſelf. If the Irritation of this Muſcle is very violent, it may occaſion that convulſive Contraction of the Diaphragm which is called an Hiccough; and therefore an Hiccough in an Inflammation of the Liver has been juſtly declared to be an ill Symptom.

An Irritation of the thoracic Nerves which produces Sneezing, may ſometimes free the phrenic Nerves from any Spaſm they occaſion; ſo that Sneezing ſometimes takes away the Hiccough, and a Derivation of the Fluid of the Nerves any other Way may do the ſame Thing: Or the Hiccough may alſo be ſometimes cured, by drawing up into the Noſe the Smoak of burning Paper, or other acrid Fumes, and by a Surprize, or any other ſtrong

Application of the Mind in thinking or in diſtinguiſhing Objects.

The *FOURTH CERVICAL* Nerve, after ſending off that Branch which joins with the third to form the Phrenic, and beſtowing Twigs on the Muſcles and Glands of the Neck runs to the Arm-pit, where it meets with the *FIFTH*, *SIXTH*, and *SEVENTH* Cervicals and *FIRST-DORSAL*, that eſcape in the Interſtices of the *Muſculi ſcaleni*, to come at the Arm-Pit where they join, ſeparate and re-join in a way ſcarce to be rightly expreſſed in Words; and after giving ſeveral conſiderable Nerves to the Muſcles and Teguments which cover the *Thorax*, they divide into ſeveral Branches to be diſtributed to all the Parts of the ſuperior Extremity. Seven of theſe Branches I ſhall deſcribe under particular Names.

1. *CUTANEUS* runs down the Fore-part of the Arm near the Skin to which it gives off Branches, and then divides on the Fore-arm into ſeveral Nerves, which ſupply the Teguments there and on the Palm of the Hand. In opening the Cephalic Vein of the Arm at the ordinary Place, the ſame Symptoms are ſometimes produced, as in opening the external Jugular Vein, and from a like Cauſe, to wit, from the hurting a Branch of this cutaneous Nerve with the Lancet.

2. *MUSCULO-CUTANEUS* or *perforans Caſſerii* paſſes through the *Coraco-brachialis* Muſcle, and, after ſupplying the *biceps flexor cubiti* and *brachiæus internus*, is ſpent on the Teguments on the out-ſide of the Fore-arm and Back of the Hand.

3. *MUSCULARIS* has a ſpiral Courſe from the *Axilla*, under the *Os humeri*, and backward to the external Part of that Bone, ſupplying by the Way the extenſor Muſcles of the Fore-arm, to which it runs between the two *brachiæi* Muſcles, to be chiefly beſtowed on the Muſcles that extend the Wriſt and Fingers; ſome of its Branches going likewiſe to the Flexors, and others ſerving the Skin on the out-ſide of the Fore-arm, the Extremity of it deſcends along the *Radius* to the Back of the Hand, in which, and in the back convex Part of the Thumb and three large Fingers it terminates.

4. *ULNARIS* is extended along the In-ſide of the Arm, to give Nerves to the Muſcles that extend the Fore-arm and to the Teguments of the Elbow; towards the lower Part of the Arm, it ſlants a little backward to come at the Groove behind the internal Condyle of the *Os humeri*, through which it runs to the *Ulna*; in its Courſe along this Bone it ſerves the neighbouring Muſcles and Teguments; and as it comes near the Wriſt, it detaches a Branch obliquely over the *Ulna* to the Back of the Hand, to be loſt in the convex Part of ſeveral Fingers. The larger Part of the Nerve goes ſtreight forward to the internal Side of the *Os piſiforme* of the Wriſt; where it ſends off a Branch which ſinks under the large Tendons in the Palm, to go croſs to the other Side of the Wriſt, ſerving the *muſculi lumbricales* and *interoſſei*, and at laſt terminating in the ſhort Muſcles of the Thumb and Fore-finger. What remains of the ulnar Nerve, after ſupplying the ſhort Muſcles of the Little-finger, di-

vides into three Branches; whereof two are extended along the Sides of the Sheath of the Tendons of the Flexors of the Little-finger, to furniſh the concave Side of that Finger; and the third Branch is diſpoſed in the ſame Way upon the Side of the Ring-finger next to the Little-finger.

When we lean, or preſs on the internal Condyle of the *Os humeri*, the Numneſs and Prickling we frequently feel, point out the Courſe of this Nerve; I have ſeen a Weakneſs and Atrophy in the Parts which I mentioned this Nerve to be ſent to, after a Wound in the internal inferior Part of the Arm.

5. *RADIALIS* accompanies the humeral Artery to the bending of the Elbow, ſerving the Flexors of the Cubit in its Way; then, after giving large Nerves to the Muſcles on the Fore-part of the Fore-arm, it continues its Courſe near to the *Radius*, beſtowing Branches on the circumjacent Muſcles. Near the Wriſt it gives off a Nerve which is diſtributed to the Back of the Hand, and the convex Part of the Thumb, and ſeveral of the Fingers. The larger Part of this Nerve paſſing behind the annular Ligament of the Wriſt, gives Nerves to the ſhort Muſcles of the Thumb, and afterwards ſends a Branch along each Side of the Sheath of the Tendons of the Flexors of the Thumb, Fore-finger, Mid-finger, and one Branch to the Side of the Ring-finger, next to the Middle, to be loſt on the concave Side of thoſe Fingers.

The Manner of the going off of theſe Nerves of the Fingers both from the *Ulnar* and *Radial*, is that a ſingle Branch is ſent from the Trunk to the Side of the Thumb and Little-finger fartheſt from the other Fingers; and all the reſt are ſupplied by a Trunk of a Nerve, which ſplits into two ſome Way before it comes as far as the End of the *Metacarpus*, to run along the Sides of different Fingers that are neareſt to each other.

It might have been obſerved, that in deſcribing the poſterior Branches of the *ulnar* and *radial Nerve*, I did not mention the particular Fingers, to the convex Part of which they are diſtributed. My Reaſon for this Omiſſion is, the Uncertainty of their Diſtribution; for tho' ſometimes theſe poſterior Branches go to the ſame Fingers, to the concave Part of which their anterior Branches are ſent, yet frequently they are diſtributed otherwiſe, and I ought to obſerve that the muſcular Nerve has not always that Termination in the Back of the Hand which I mentioned.

6. *ARTICULARIS* ſinks downwards at the *Axilla*, to get below the Neck of the ſuperior Head of the *Os humeri*, and to mount again at the Back-part of it; ſo that it almoſt ſurrounds the Articulation, and is diſtributed to the Muſcles that draw the Arm back and to thoſe that raiſe it up.

7. *SCAPULARIS* runs ſtreight to the *Cavitas ſemilunata* of the upper *Coſta* of the *Scapula*, which is an Hole in the recent Subject, a Ligament being extended from one Angle of the Bone to the other, giving Nerves in its Way to the Muſcles of the *Scapula*. When it has paſſed this Hole it ſupplies the *Supraſpinatus* Muſcle, and then deſcending at the an-

anterior Root of the *Spine* of the *Scapula*, it is loſt in the other Muſcles that ly on the *Dorſum* of the *Scapula*.

The Situation of theſe brachial Nerves in the *Axilla*, may let us ſee, how a Weakneſs and Atrophy may be brought on the Arms by long continued Preſſure of Crutches, or ſuch other hard Subſtances on this Part; and the Courſe of them from the Neck to the Arm may teach us, how much better Effects, Veſicatories or ſtimulating nervous Medicines would have, when applied to the Skin, covering the tranſverſe Proceſſes of the *Vertebræ* of the Neck or at the *Axilla*, than when they are put between the Shoulders, or upon the ſpinal Proceſſes in Convulſions or Palſies of the ſuperior Extremities, where a *Stimulus* is required.

The *TWELVE DORSAL* Nerves of each Side as ſoon as they eſcape from between the *Vertebræ*, ſend a Branch forward to join the Intercoſtal, by which a Communication is made among them all, and they ſoon likewiſe give Branches backwards to the Muſcles that raiſe the Trunk of the Body, their principal Trunk being extended outwards to come at the Furrow in the lower Edge of each Rib, in which they run toward the anterior Part of the *Thorax*, between the internal and external intercoſtal Muſcles, giving off Branches in their Courſe to the Muſcles and Teguments of the *Thorax*.

The *FIRST* Dorſal, as was already obſerved, is particular in this, that it contributes to form the brachial Nerves, and that the two Branches of the Intercoſtal, which come down to the *Thorax*, form a conſiderable Ganglion with it.

The *SIX* inferior dorſal Nerves give Branches to the Diaphragm and abdominal Muſcles.

The *TWELFTH* joins with the firſt Lumbar, and beſtows Nerves on the *Muſculus quadratus Lumborum* and *Iliacus internus*.

May not the Communications of all theſe Nerves be one Reaſon, why the Parts they ſerve act ſo uniformly and conjunctly in Reſpiration, and conſpire together in the convulſive Motions of Coughing, Sneezing, *&c*?——The twitching Spaſms that happen ſometimes in different Parts of the Muſcles of the *Abdomen*, by any Irritation on the Branches of the lower dorſal Nerves are in Danger of occaſioning a Miſtake in Practice, by their Reſemblance to the Colick, *Nephritis*, *&c*—. The Communications of theſe lower ones with the Intercoſtals may ſerve to explain the violent Effort of the abdominal Muſcles in a *Teneſmus* and in Child-bearing.

As the Intercoſtal is ſo much larger in the *Thorax* than any where elſe, and ſeems to diminiſh gradually as it aſcends and deſcends, there is ſome Cauſe to ſuſpect that this is the Trunk from which the ſuperior and inferior Parts are ſent as Branches.

The *FIVE LUMBAR* Nerves on each Side communicate with the Intercoſtal and with each other, and give poſterior Branches to the Loins.

The *FIRST* communicates with the laſt dorſal, ſends Branches to the abdominal Muſcles, to the *Pſoas* and *Iliacus*, and to the Teguments and Muſcles on the anterior Part of the Thigh; while its principal Branch joins with the other Nerves to form the crural Nerve.

The *SECOND LUMBAR* Nerve paſſes

through the *Pſoas Muſcle*, and is diſtributed nearly in ſame Way as the former, as is alſo the *THIRD*.

Branches of the *firſt*, *ſecond* and *third* make up one Trunk, which runs along the Fore-Part of the *Pelvis*, and paſſing in the Notch at the anterior Part of the great Hole common to the *Os Pubis* and *Iſchium*, is ſpent on the *Adductor* Muſcles and on the Teguments on the Inſide of the Thigh. This Nerve is called the *OBTURATOR* or *POSTERIOR CRURAL NERVE*.

By united Branches from the *firſt*, *ſecond*, *third* and *fourth* lumbar Nerves, a Nerve is formed that runs along the *Pſoas* Muſcle, to eſcape with the external Iliac Veſſels out of the *Abdomen*, below the tendinous Arcade of the external oblique Muſcle. This Nerve, which is named the *ANTERIOR CRURAL*, is diſtributed principally to the Muſcles and Teguments on the Fore-Part of the Thigh. A Branch however of this Nerve runs down the Inſide of the Leg to the ſuperior Part of the Foot keeping near to the *Vena ſaphæna*; in opening of which with a Lancet at the Ancle, the Nerve is ſometimes hurt and occaſions ſharp Pain at the Time of the Operation, and Numneſs afterwards.

The Remainder of the fourth Lumbar and the fifth join in compoſing the largeſt Nerve of the Body, which is ſoon to be deſcribed.

Whoever attends to the Courſe of theſe lumbar Nerves, and of the ſpermatic Veſſels and Nerves upon the *Pſoas* Muſcle with the oblique Paſſage of the *Ureter* over that Muſcle, will not be ſurprized, that when a Stone is paſſing in this Canal, or even when it is inflamed, the Trunk of the Body cannot be raiſed erect without great Pain; or that the Skin of the Thigh becomes more inſenſible, and the Thigh is drawn forward, and that the Teſticle often is drawn convulſively towards the Ring of the abdominal Muſcles.

The *SIX PAIR* of the *FALSE VERTEBRÆ* conſiſt each of ſmall poſterior Branches ſent to the Hips, and of large anterior Branches.

The *firſt*, *ſecond* and *third*, after coming thro' the three upper Holes in the Forepart of the *Os ſacrum*, join together with the fourth and fifth of the Loins, to form the largeſt Nerve by much of the Body, which is well known by the Name of *SCIATIC* or *ISCHIATIC* Nerve: This, after ſending large Nerves to the different Parts of the *Pelvis*, and to the external Parts of Generation and the *Podex*, as alſo to the Muſcles of the Hips, paſſes behind the great *Tuber* of the *Os Iſchium*, and then over the *Quadrigemini* Muſcles to run down near to the Bone of the Thigh at its back Part, giving off Nerves to the neighbouring Muſcles and Teguments. Some Way above the Ham, where it has the Name of the *Poplitæus* Nerve, it ſends off a large Branch that paſſes over the *Fibula*, and ſinking in among the Muſcles on the anterior external Part of the Leg, runs down to the Foot, to be loſt in the ſuperior Part of the larger Toes, ſupplying the neighbouring Muſcles and Teguments every where in its Paſſage. The larger Branch of the *Sciatic*, after giving Branches to the Muſcles and Teguments about the Ham and Knee, and ſending a large cutaneous Nerve down the Calf of the Leg, to be loſt at laſt on the exterior Side of the Foot and ſuperior Part of the leſſer Toes, ſinks below the *Gemellus* Muſcle, and diſtributes Nerves to the Muſcles on the Back of the Leg; among which it continues its Courſe, till paſſing behind the internal *Malleolus*, and in the internal Hollow of the *Os calcis*, it divides into the two plantar Nerves. The internal of which is diſtributed to the Toes in the ſame Manner as the radial Nerve of the Hand ſerves the concave Side of the Thumb and Fingers, and the external Plantar is divided and diſtributed to the Sole of the Foot and Toes, nearly as the ulnar Nerve is in the Palm of the Hand and in the concave Part of the Fingers.

By applying what was ſaid of the Nerves in general to the particular Diſtribution of the Nerves of the inferior Extremities, we may ſee how People with fractured Legs, eſpecially where there are Splinters, ſhould be ſo ſubject to convulſive Startings of the fractured Member;——Why upon tying the Blood-veſſels in an Amputation of the Leg, the Patients ſhould ſometimes complain of violent Pain in their Toes;——Why ſuch Patients ſhould alſo be troubled with Startings;——Why, for a conſiderable Time after the Amputation of the diſeaſed Limb, when the Suppuration is well advanced, they ſhould complain of Pain in the Sore which occaſioned the Amputation.

The *FOURTH*, which with the two following is much ſmaller than the three ſuperior, ſoon is loſt in the *Veſica urinaria* and *Inteſtinum rectum*.

The *FIFTH* comes forward between the Extremity of the *Os ſacrum* and *Coccygis*, to

be

be diſtributed principally to the *Levatores Ani*.

The *SIXTH* advances forward below the broad Shoulders of the firſt Bone of the *Os Coccygis*, and is loſt in the *Sphincter Ani* and Teguments covering it.

The Branches of the four laſt cervical Nerves, and of the firſt dorſal, which are beſtowed on the ſuperior Extremity, and the two Crurals, with the Sciatic, which are diſtributed to the inferior Extremities, are much larger proportionally to the Parts they ſerve, than the Nerves of the Trunk of the Body, and eſpecially of the *Viſcera* are; and for a very good Reaſon, that in the moſt common neceſſary Actions of Life a ſufficient Quantity of Fluid, on which the Influence of Nerves ſeems to depend, may be ſupplied to the Muſcles there, which are obliged to perform ſo frequent and violent Contractions.— The Size of the Nerves of the inferior Extremities ſeems larger proportionally than in the ſuperior Extremities, the inferior Extremities having the Weight of the whole Body to ſuſtain, and that frequently at a great Diſadvantage. What the Effect is of the Nerves here being injured, we ſee daily, when People happen by ſitting wrong to compreſs the ſciatic Nerve, they are incapable for ſome time after to ſupport themſelves on the affected Extremity; and this is ſtill more remarkable in the *Sciatic* or *Hip-Gout*, in which the Member is not only weakned, but gradually ſhrivels and waſtes.

OF

# OF THE *Syſtole* and *Diaſtole* OF THE HEART,

## And the Reciprocal Actions of its AURICLES and VENTRICLES.

THAT the Account I am to give of the alternate Motions of the Heart may be rightly underſtood, it will be neceſſary to premiſe the following Propoſitions on which it depends.

1. All Muſcles are furniſhed with Blood-veſſels and Nerves, and their Action depends on the Influx of Blood, and of the nervous Fluid into their muſcular Fibres; therefore whenever Muſcles are deprived of a ſufficient Quantity of either one or other of theſe Li-

quors or of both, their Action is weakned or ceaſes. The Truth of this has been fully proved by the Experiments of compreſſing, tying and cutting the Nerves or Arteries of Muſcles.

2. All Muſcles are in a conſtant State of Action, as long as Blood and nervous Fluid are freely ſupplied to them. This ſeems evident from the continued Contraction of the Sphincters of the Bladder and *Anus*, and of Muſcles, whoſe Antagoniſts are cut aſunder or become paralytic.

Though in theſe two Propoſitions, I have aſſumed a Fluid of the Nerves, for the Probability of which, ſee the Arguments in the foregoing Treatiſe, yet to avoid a Diſpute, it may be here remarked, that the following Account of the Heart's Motions will equally hold good, by ſuppoſing the Nerves to be ſolid Cords acting by Elaſticity, Vibration, *&c.* if it is only granted, that their Action is neceſſary to the Contraction of Muſcles, and that Compreſſion is capable to hinder that Action, which Experiments plainly ſhew it is.

3. The Nerves of the Heart paſs to it between the two Auricles or two Arteries, and between the Auricles and Arteries.

4. The *Coronary* Arteries, which are the only ones that ſupply the Heart, riſe from the *Aorta* immediately above the middle looſe Part of the ſemilunar Valves, in the ſame Height of the *Aorta* as where the Angles of theſe Valves are fixed.

5. The Edges of the ſemilunar Valves are duplicated with a muſcular Corpuſcle in the Middle, and muſcular Cords running oblique-

ly from that Corpuſcle to the Inſertion of the Valves into the *Aorta*.

The Truth of theſe three laſt Propoſitions is evident from Diſſections.

6. Before the Veſſels in which the Circulation is performed can act, it is neceſſary to ſuppoſe them full of their Liquors, otherwiſe the whole vaſcular Syſtem could not be all at once put into Action, and the Motion of the Fluids ſent out from the Heart, could not be propagated to that in the returning Veſſels; conſequently the Circulation would be ſtopped almoſt as ſoon as begun.

If then both Auricles and Ventricles attempt upon the firſt Communication of Motion, to contract, the Ventricles being ſtronger will force their own Contraction, and hinder the Contraction of the Auricles, which muſt be, in the mean time, much dilated by the Influx of Blood from the the Veins (Prop. 6.) and at this Time the Arteries are alſo diſtended by the Blood thrown out of the Ventricles; therefore the Cardiac Nerves lying between them, (Prop. 3.) will be compreſſed and prevented from exerting their Office. While this happens to the Nerves, the Blood ruſhing out of the left Ventricle into the *Aorta*, and thruſting the ſemilunar Valves outwards and upwards, diſtends the great Artery conſiderably, whereby the Valves are ſtretched, and their lunated Edges are brought to be ſtreight and as high as their Angles; conſequently theſe Edges, thus raiſed and preſſed to the Sides of the *Aorta*, are made to cover the Orifices of the *Arteriæ coronariæ*, which the Corpuſcles will aſſiſt to do more adequately; and therefore, while they are in this Situation, no Blood can be ſent to the Subſtance of the Heart. If then the Nerves do not exert their Office, and Acceſs is denied to the Blood, this Muſcle, the Heart muſt (by Prop. 1.) become paralytic or unactive.

The Auricles, which were attempting all this Time to contract themſelves, will now, when the Reſiſtance to them is removed, throw the Blood they contain into the Ventricles; and the Arteries that were violently diſtended while the Ventricles puſhed the Blood into them, will at this ſame Time when the Ventricles ceaſe to act, conſtrict themſelves; and the *Valvulæ ſemilunares* will, by their Elaſticity, aſſiſted by the muſcular Corpuſcles and Cords, be depreſſed inwards. Since then, by the Conſtriction of the Auricles and Arteries, the Nerves of the Ventricles are freed from the Compreſſion they ſuffered while the Auricles and Arteries were diſtended; and ſince the Blood in the *Aorta* preſſed ſtrongly by the contracting Sides of this Artery, and reſiſted by the Liquors which are to be thrown through all its Branches, is alſo puſhed with great Force on the Orifice of the left Ventricle, thruſts back the ſemilunar Valves which ſtop its Entry into that Cavity, and impetuouſly ruſhes into the coronary Arteries: Since then, I ſay, the Nerves of the Heart are again free from Compreſſion, and the Blood is again ſent to the Heart by its Arteries, its muſcular Fibres muſt again contract (by Prop. 2.) And thus, as long as theſe Cauſes continue to act and ceaſe alternately, their Effects muſt be exerted in the ſame

Manner; that is, as long as an Animal lives, the Heart muſt have an alternate State of Contraction, called its *Syſtole* and of Relaxation or *Diaſtole*; and the Auricles and Arteries muſt be dilated, while the Ventricles are contracting, and the Ventricles muſt be dilated while the Auricles and Arteries are conſtricted, or their Actions muſt always be reciprocal.

THE

# THE DESCRIPTION

## Of the Human

## *Lacteal Sac* and *Duct*.

THE *Receptaculum Chyli* of *Pecquet*, or *Saccus lacteus* of *Van Horne*, is a membranous ſomewhat pyriform Bag, two Thirds of an Inch long, one third of an Inch over in its largeſt Part when collapſed; ſituated on the firſt *Vertebra* of the Loins to the Right of the *Aorta*, a little higher than the right emulgent Artery, behind the right inferior Muſcle of the Diaphragm; it is formed by the Union of three Tubes, one from under the *Aorta*, the ſecond from the Interſtice of the *Aorta* and *Cava*, the third from under the Emulgents of the right Side. The *Lacteal Sac*, becoming gradually ſmaller towards its ſuperior Part, is contracted into a ſlender membranous Pipe, of about a Line Diameter, which is generally named, The *THORACIC*

*DUCT.* This paſſes betwixt the muſcular *Appendices* or inferior Muſcles of the Diaphragm, on the Right of, and ſomewhat behind the *Aorta*; then, being lodged in the cellular Subſtance behind the *Pleura*, it mounts between the *Aorta* and the *Vena Azygos* as far as the fifth *Vertebra* of the *Thorax*, where it is hid by the *Azygos* as this Vein riſes forwards to join the deſcending or ſuperior *Cava*, after which the Duct paſſes obliquely over to the left Side behind the *OEſophagus*, *Aorta deſcendens*, and great Curvature of the *Aorta* until it reaches the left carotid Artery; behind which, and on the left Side of the *OEſophagus* it runs to the Interſtice of the firſt and ſecond *Vertebra* of the *Thorax*, where it begins to ſeparate from the carotid, ſtretching farther towards the left internal Jugular Vein by a circular Turn, whoſe convex Part is uppermoſt. At the Top of this Arch it ſplits into two for a Line and an half, the ſuperior Branch receiving into it a large lymphatic Veſſel from the cervical Glands. This Lymphatic appears, by blowing Air and injecting Liquors into it, to have no Valves; when the two Branches are again united, the Duct continues its Courſe towards the internal Jugular Vein, behind which it deſcends, and immediately at the left Side of the Inſertion of this Vein enters the ſuperior poſterior Part of the left ſubclavian Vein, whoſe internal Membrane duplicated forms a ſemilunar Valve that is convex externally, and covers two Thirds of the Orifice of the Duct; immediately below this Orifice, a cervical Vein from the *Muſculi ſcaleni* enters the ſubclavian.

The Coats of the *Sac* and *Duct* are thin tranſparent Membranes; from the Inſide of which, in the Duct, ſmall ſemilunar Valves are produced, moſt commonly in Pairs; which are ſo ſituated, as to allow the Paſſage of Liquors upwards, but oppoſe their Return in an oppoſite Courſe. The Number of theſe is generally ten or twelve.

This is the moſt ſimple and common Courſe, Situation and Structure of the *Receptaculum chyli* and *thoracic Duct*; but having had Occaſion to obſerve a Variety in theſe Parts of different Subjects, I ſhall ſet down the moſt remarkable of them.

The Sac is ſometimes ſituated lower down than in the former Deſcription, is not always of the ſame Dimenſions, is not compoſed of the ſame Number of Ducts, and frequently appears divided into ſeveral ſmall Cells, inſtead of being one ſimple Cavity.

The Diameter of the Duct is various in moſt Bodies, and is ſeldom uniform in the ſame Subject; but frequently ſudden Enlargements or *Sacculi* of it are obſerveable.——The Diviſions which Authors mention of this Duct are very uncertain. I have ſeen it divided into two, whereof one Branch climbed over the anterior Part of the *Aorta* at the eighth *Vertebra* of the *Thorax*, and at the fifth ſlipped behind that Artery, to join the other Branch which continued in the ordinary Courſe.—— The preciſe *Vertebra*, where it begins to turn to the left Side, is alſo uncertain.—— Frequently it does not ſplit at its ſuperior Arch; in which Caſe a large Sac is found near its Aperture into the ſubclavian Vein.—— Generally it has but one Orifice; though I have ſeen two in one Body, and three in another: Nay ſometimes it divides into two, under the Curvature of the great Artery; one goes to the right, another to the left Subclavian Vein; and I have found this Duct diſcharging itſelf entirely into the right Subclavian.—— The lymphatic Veſſel which enters its ſuperior Arch, is often ſent from the *thyroid* Gland.

Whether is not the Situation of the *Receptaculum chyli* ſo much nearer the muſcular *Appendices* of the Diaphragm in Men than in Brutes, deſigned to ſupply the diſadvantageous Courſe the Chyle muſt otherwiſe have in our erect Poſture?

Does not the Deſcent of the Extremity of the Duct to the ſubclavian Vein, and the opening of the lymphatic into the Top of the Arch, contribute to the ready Admiſſion of the Chyle into that Vein?

*FINIS.*

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# ERRORS of the Preſs.

**PAGE** 4. Line 15. for *Perioſtium*, read *Perioſteum*. p. 17. l. 23. for ought be, r. ought to be. p. 20. l. 2. for ſcorbutick pocky, r. ſcorbutick or pocky. p. 22. l. 27. for thicker r. thick. p. 28. l. 7. for Trohanters, r. Trochanters, p. 40. l. 10. for Spenoid r. Sphenoid. p. 59. l. ult. p. 60. l. 1. p. 122. l. 28. for ſtraight, r. ſtreight. p. 68 l. 14. for *Euſtachins* mentions, r. *Euſtachius* (*f*) mentions. p. 95. l. 32 p. 126. l. 2. p. 167. l. 4. p. 256. l. 7. for flatned, r. flatted. p. 97. l. 11. for, ſo as as, r. ſo as. p. 98. l. 34. p. 239. l. 19. p. 264. l. 20. for centre, r. center. p. 112. l. 14. for Nerves, r. Nerve. p. 115. l. 34. for (*e*) r. (*a*.) p. 137. l. 28. for *Lieutand* r. *Lieutaud*. p. 164. l. 14. for tilages, r. Cartilages. p. 189. l. 13. for *Vertebra*, r. *Vertebræ*. p. 211. l. 15. for longer, r. ſhorter, p. 220. l. 4. for an, r. of an. p. 220, l. 28. for *Pthiſis* r. *Phthiſis*. p. 222. l. 12. for Part, r. Parts. p. 236. l. 13. for Surface, r. Surfaces. p. 262 l. 8. for is, r. are. p. 269. l. 32. for majoor, r. major. p. 350. l. 33. for planly, r. plainly. p. 358. l. 13. for Globe of the Eye, r. Globes of the Eyes. *Ibid.* l. 16. for the, r. each.